ANNALS

OF

SURGERY

A MONTHLY REVIEW OF SURGICAL SCIENCE AND PRACTICE.

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ANNALS OF SURGERY

THE PRESENT POSITION OF ANTISEPTIC SURGERY.[1]

By J. WILLIAM WHITE, M.D.,

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FOR several years it has been my custom in my lectures
at the University of Pennsylvania, to pass rapidly over
the evidence in support of the antiseptic theory of wound treat-
ment, with the remark that the time for argument had passed
and that it was merely necessary now to present such facts as
might serve to make clear the principles involved and to em-
phasize the enormous benefit that has resulted from the appli-
cation of those principles to practical surgery. It seemed to
me that the theory of antisepsis rested upon a mass of corre-
lated facts, experimental, clinical and bacteriological, sufficient
to establish it on a firm foundation, and that the only debatable
ground remaining was that relating to the selection of methods
and the improvement of details. I considered that the prob-
lem had been so scientifically stated and that its solution had
been so thoroughly accomplished that, as regarded the general
principles, no opposing views worthy of mention remained for
discussion or refutation.

I also thought that the whole history of the development and
establishment of this great theory, while including the admir-
able labors of hundreds of medical men in all parts of the world
and constituting one of the brightest chapters in the record of
human progress, yet centered around the figure of the English-
speaking surgeon, whose name was identified with it from its

[1] A reply to Mr. Tait's recent criticism of Sir Joseph Lister's Berlin Address.

Read in the post-graduate course of the University of Toronto, December 19, 1890.

incipiency, in whose mind the grand conception first took practical and definite shape, and whose patient, unassuming, conscientious work in elevating his original thought into a working hypothesis and in transforming the latter into a theory of world-wide acceptance, seemed to me to present perhaps the best, and certainly the most important, example of the application of purely scientific methods to practical surgery to be found in the history of the profession.

These, I say, have been my views, stated more and more dogmatically to successive classes as time went on, and with less and less thought of possible error or of contradiction from respectable surgical authorities. Of course there are always persons in every profession and in every community whose brain cells react to new thoughts and ideas as their grosser tissues to foreign bodies. A condition of irritation is set up followed by the expulsion of the intruder or by its encapsulation and virtual disappearance. Vaccination for variola has to-day its dozens of bitter opponents; for other infective diseases, its hundreds of skeptics; the theory of evolution which has revolutionized the natural science of this century is still violently attacked; and although the laws of gravitation and of planetary motion are now quite generally admitted, we have in Virginia a colored clergyman who still proclaims his belief in the sun's motion. As regards the antiseptic theory we can usually afford to turn a deaf ear to this class of opponents, many of whom have about as much claim to speak with authority on surgical or scientific topics as the Reverend Mr. Jasper on astronomical subjects.

When, however, a noted surgeon, a successful operator and a vigorous controversialist undertakes to traverse the whole line of thought and argument upon which my confident acceptance of the theory was founded, denies its basal facts, ridicules its logic, jeers at its methods, challenges its records and abusively attacks its author and his supporters; and when I find such views, so expressed, published and republished in the most reputable medical journals of the day, with little or no editorial censure, it seems to me proper that those of us who are teachers should once more review the evidence, consider the situation and, according to our conclusions, publicly

re-affirm or renounce our faith in the theory and practice of antisepsis.

On the 4th of last August I had the pleasure of hearing Sir Joseph Lister deliver before the International Medical Congress at Berlin, an address upon "The Present Position of Antiseptic Surgery." He evidently did not think it necessary in the presence of that vast audience, containing many of the most distinguished men in Europe and America, to defend or even to re-state his position as to antisepsis, but devoted his time to noting the new light which had been thrown on the behavior of wounds by the results on the one hand of Koch's discovery of the method of cultivating microbes upon solid media, and on the other of Metchnikoff's researches into the phagocytic action of the migratory or amœboid cells of the human body. According to Lister, Koch's work has rendered it possible to study with greater precision than ever before the habits and behavior of micro-organisms and he instanced the discovery of the cholera microbe as a notable example of the results of this method. Detailing some of Metchnikoff's experiments to prove the antibacteric action of normal leucocytes, he called attention to the explanation it offered of much that was hitherto mysterious in the relation of micro-organisms to wounds, the healing, for instance, of wounds like that made in the operation for hare-lip, the posterior edge of which is perpetually bathed in saliva containing septic bacteria. The destruction of these microbes by the leucocytes which people the lymph at the edge of the wound satisfactorily explains the rapid healing which we uniformly obtain after this operation. So, too, he thought that in cases where fine silk ligatures are used unpurified and left in closed wounds the phagocytic action of the normal tissues may destroy the microbes that have gained access to the interstices of the thread and prevent their fermentation or putrefactive action on the discharges.

He then considered the question of drainage and of irrigation, pointing out the possibility of dispensing with both in many wounds, and suggesting that in the new light thrown upon the ability of normal tissues to protect themselves, contamination from atmospheric organisms may perhaps also be disregarded, provided no septic matter be otherwise introduced

into wounds.   In support of this he noted the fact that it had
been found that the free entrance of air containing microbes
into the pleural cavity in cases of empyema had produced no
harmful results in the days when the spray was irrationally de-
pended upon to sterilize such air, and instanced the transfor-
mation of the purulent contents of the pleural cavity into a
rapidly diminishing serous effusion, the closure of the external
opening, the resumption of the normal functions of the pleura,
the expansion of the contracted lung through atmospheric
pressure,[2] etc., as a beautiful example of the reparative processes
of nature when uninterfered with by mischievous agents from
extrinsic sources.   The contrasting course of those cases in
which in pre-antiseptic days the discharges escaping from the
wound became infected and underwent putrefactive fermenta-
tion, is familiar to most of you.

He then emphasized the need for antiseptic rather than
aseptic dressings in cases where large discharge is unavoidable
and concluded with a reference to the double-cyanide dressing
which he has been using for eighteen months.

This address seemed to me as I listened to it to be another

[2]This statement Mr. Tait critisises (if it can be called criticism) most violently,
calling on the "shades of Newton and Toricelli" in mock dismay at the disregard
of physical laws which he thinks it manifests.   He misquotes Lister who spoke of
the closure of "the external opening."   This Tait transforms into "closure of the
affected cavity" and then says that "given a membrane to which the atmosphere
has free access on both sides on both of these sides the pressure of the atmosphere
will be exactly the same"—a self-evident proposition but one which has nothing to
do with the condition of the lung and pleura after the chest wall has become imper-
vious.   He says, also, that when the closure of the pleural cavity is completed "the
natural dimensions of the affected lung are *always* remarkably diminished."   In
contradiction of his whole position in this matter I would refer to the following au-
thorities: West, on Pneumothorax (*The Lancet*, 1887, vol. 2, p. 353); Williams
on the use of a Valvular Tube in Empyema (*British Medical Journal*, May 18
1889); Reynolds, on Pneumothorax Consecutive to Emphysema (*Manchester Medi-
cal Chronicle*, October, 1889); Douglass Powell, on Variations in Intra-horacic
Pressure (*Transactions of International Medical Congress*, 1881, vol. 2); Don-
aldson, on Diseases of the Pleura, (*American System of Medicine*, vol. 3 pp. 522,
559).   The latter author says: "The dilatation of the lung is produced by the disap-
pearance of the intra-pleural pressure and the pressure in the opposite direction,
from the bronchial surface."   The whole question is, of course, a distinct digression
but is used by Tait in justification of his assertion that Lister "possesses crude
notions of logical definition."!

striking example of Lister's remarkable willingness to receive
and profit by all new discoveries and all genuine advances
bearing upon the antiseptic theory. So far as I know he has
never remained silent in the face of satisfactory demonstration
that any portion of his method was unnecessary or illogical.
As he gave up the spray when it became evident that it was
not accomplishing its work, as he has from time to time dis-
carded various antiseptics in the search for the ideal one com-
bining permanency and certainty of action with absence of
irritating qualities, so he now is willing to minimize the dan-   .
gers of atmospheric contamination and to discard washing, ir
rigation, and even drainage in appropriate cases although for
years he has been conscientiously emphasizing their import-
ance. Surely this is the true scientific spirit, as rare as it is
admirable, and an additional evidence of the single-mindedness
and absolute fairness of this great investigator.

On the 27th of last September there appeared in The *British
Medical Journal* an article by Mr. Lawson Tait, consisting of
an address delivered a short time previously and entitled "The
Present Aspect of Antiseptic Surgery; A Criticism of Sir
Joseph Lister's Address at the International Congress."

Of the tone, taste and temper of this essay I shall have but
little to say. It would be difficult to characterize it properly
and preserve the dignity and decorum which should belong to
scientific discussion, but which are so conspicuously absent in
Mr. Tait's paper. So far, however, as concerns our present
purpose it may be considered from two standpoints: 1. As it
denies the truth of the principles underlying the practice of
antisepsis, and advances an alternative theory applicable to the
treatment of wounds. 2. As it attacks the prevailing anti-
septic methods.

1. THE PRINCIPLES INVOLVED. Mr. Tait draws an elaborate
comparison between the phlogiston theory of Stahl and the
antiseptic theory, asserting, to use his own words, that we have
a perfect parallel to the former in "the septic theory of inflam-
mation and fever which is the favorite hobby-horse of our own
day." He adds "everything at present has a septic origin and
a septic inception, yet I venture to say that before the
present generation has run out the word antiseptic will be

all that is left to represent the strange structure, just as anti-phlogistic was the only word left to represent the phlogistic theory in the middle of the present century." He continues by asserting a want of logic in the use of the term "theory" at all, saying that "instead of the septic or antiseptic fact, Lister and his still more illogical disciples talk of the septic or anti-septic theory, whereas there is no theory about it at all, but an absolute and ludicrous logical error." He then opens his argument by denying that the cholera bacillus has been definitely isolated or that it can be cultivated with certainty and precision; and says that even if it has and if it is potent for production or reproduction, the fact that if a thousand people drink the same germ-infected water only a hundred or so will be affected, and that the majority of these will recover, shows that the facts about germs in the human body do not coincide with the facts of the germs in the gelatine flasks and that, therefore, they cannot stand as the basis of a working hypothesis, far less of a theory.

.It is difficult to follow the vagaries of this extraordinary paper, but if all this means anything whatever it means that, taking the cholera bacillus as a type, all deductions based upon bacteriological investigation are denied because the growth and reproduction of micro-organisms in the body are so influenced and altered by physiological and vital processes as to run a course somewhat different from that which they take in flasks or test-tubes. For the same general reason and because it will not immediately explain the differences among the clinical courses of various infective diseases Mr. Tait rejects the phagocyte theory, apparently assuming that if it is true there should be a uniform destruction of bacilli of all varieties. One might as well deny the essential element of conception, the fusion of the ovum and sperm cell—possibly an instance of phagocytosis—because of the variations in the resulting animal. This position is, however, in harmony with his denial of the value of vivisection for similar reasons, and illustrates the working of a mind which he is pleased to consider "logical." The assumption that this is what he is clumsily attempting to say is also justified by several other paragraphs which will serve at once to display his real ignorance of the teachings of Lister and to

illustrate the character of his address. He says "If the en-
trance of germs into a wound was the immediate and real cause
of suppuration and of consequent poisoning the device of the
spray was the most completely logical appliance that could
have occurred to the mind of man." "Even if the phagocytes
are the means by which the tissues resist the omnipotent and
ever-present germs it is the phagocytes and their conditions
which must constitute the really important elements of the
question; keep your phagocytes up to the mark and you need
never bother about germs." "With the Listerian one germ is
as good as a thousand." "If it would gratify the phagocytes
in any way I would stuff the abdomen like pudding with the
germs or bacilli of decomposition provided there was nothing
present for them to feed upon." He finally sums up his position
in the two following paragraphs—Lister's view was "Keep out
the germs and you may leave blood-clot (and other matters) to
take care of themselves." My view was and is, "Get out all de-
composable matter and you can let the germs in freely." "There
are two factors in the trouble and it can be shown conclusively
that one, the germs, are wholly inconsiderable without
pabulum on which to feed; whilst the other, the pabulum is
sure to breed•trouble because it is practically and mechanically
impossible to keep the germs out; they exist already in the
blood and elsewhere, and are ever present according to the
best authorities."

This amount of quotation I was reluctantly compelled to
make to elucidate his views but we may now ask "what are the
facts in the case?"

The evidence necessary to prove the definite etiological rela-
tion of a particular micro-organism to a specific disease in man
is as follows: The organism must be unmistakeably recogniz-
able at different periods of its growth; it must be isolable; it
must be capable of cultivation alone and free from association
with other organisms; it must be invariably associated with the
disease in question; it must be capable by inoculation of pro-
ducing that disease; it must retain this power through an indef-
inite series of cultures. If these conditions were fulfilled in
but a single instance it would be sufficient to demonstrate the
folly of the general attack on all germ theories contained in

Tait's paper,—but at least five well-known examples may be
mentioned of indisputable relation of cause and effect between
specific pathogenic microbes and infective disease. Since 1879
when Koch first demonstrated the connection between definite
micro-organisms and various wound diseases the evidence has
steadily accumulated. Ogston in 1881, Rosenbach and Cheyne
in 1884, Passet in 1885, Zuckermann in 1887, have shown that
the various staphylococci have as distinct a causative relation
to acute suppuration as has the yeast plant to the alcoholic
fermentation.   They can be found in and cultivated from the
pus in every recent abscess; they invariably produce suppura-
tion when pure cultures are injected, even to the twentieth
generation.   Their effect may or may not be aided by the
ptomaines which they produce, but as the amount of pto-
maines is directly proportionate to the number of microbes pres-
ent and as the ptomaines are never produced at all in the absence
of the microbes the question as to the relative importance of
the two has, as Senn long ago said, but little interest for the
practical surgeon, and can have none at all for the "purely un-
scientific person" that Mr. Tait with truthfulness represents
himself to be.

Another example is to be found in malignant pustule, the
specific cause of which, the bacillus anthracis, is readily cul-
tivated in different media and produces the disease when in-
oculated in the smallest possible quantity.

Fehleisen in 1883 showed that erysipelas depended upon a
streptococcus, inoculation of which when quite pure produced
the disease in six out of seven cases, the exception occurring
in a person who had recently had an attack of erysipelas and
was scarcely more than convalescent.

Acute osteo-myelitis has until recently been thought to be
due to the ordinary microbes of suppuration, but the researches
of Becker and Krause (1883) and others have made it probable
that a specific micrococcus is the essential element of the
disease.

Tubercle furnishes the last of our examples of microbic dis-
ease and we have just learned that to Koch, who in 1882 dis-
covered the tubercle bacillus, we possibly owe the equally
brilliant and infinitely more important discovery of its antidote.

In the face of this collection of facts, of such transcendent importance to surgery and to the world at large, we can afford to pass by without further mention the bacilli of tetanus, typhoid fever, and glanders, the micrococci of lobar pneumonia and of gonorrhœa, and the microbes of cholera and of gangrene, although it is quite clear to all persons capable of weighing scientific evidence that it is a question of time only, when our knowledge of these microbes shall be as definite as of those I have enumerated.

In the face of this evidence we may assume that Tait's general and contemptuous rejection of *all* surgical theories dependent upon our knowledge of germs is not warranted by the facts in so far as suppuration, erysipelas, tubercle, anthrax, and osteo-myelitis are concerned, and therefore that there is no *a priori* ground for rejecting *every* theory involving a belief in the potency for mischief of micro-organisms.

It is more directly to the point, however, to inquire into the evidence in favor of the germ theory of septic wound disease, and here we must briefly consider some very elementary questions. Mr. Tait takes great pains in one portion of his paper to emphasize the fact that "such bacilli as cause decomposition and such as have specific properties split out from dead organic matter some horrid things," i.e. in other words that they act as ferments causing that form of fermentation which we know as putrefaction. Mr. Tait is as usual inaccurate in his statement —as the *micrococcus erysipelatosus*, for example, which is undoubtedly a microbe with specific properties, does not cause any putrid change; but he would have been correct in asserting that all organisms produce changes in the materials in which they grow, which means that they all cause *some* kind of fermentation.

The antiseptic treatment of wounds might under Mr. Tait's ruling be described as a treatment directed against the causes of putrefaction in wounds, but a more accurate definition expands it, as Mr. Cheyne has suggested, so as to include treatment directed against the cause not merely of the putrefactive fermentation but of all fermentations. Accepting this very liberal definition our scientific evidence leads us to the adoption of the antiseptic theory by the following steps, each of

which is as demonstrable as the single rule of three or the
pons asinorum.

Fermentation (whether putrefactive or otherwise) in organic
substances, such as blood clot or serum or pus, or the dis-
charges from wounds, depends upon the access to these sub-
stances of micro-organisms. The proofs of this fact are two-
fold. Experimentally it is shown by the certainty with which
easily decomposable substances like blood, urine, or beef tea
may be kept indefinitely sweet by simply protecting them
from germ contamination. Clinically it forms the basis of all
subcutaneous surgery; explains the difference between simple
and compound fractures and, taken in conjunction with another
fact,—viz., that the fluids and tissues of the healthy living body
are practically sterile, it also explains the difference between
the behavior of a case of arterial occlusion affecting a portion
of the surface of the body and producing gangrene or slough-
ing, and a case of similar occlusion affecting an internal organ
and producing atrophy and retrograde metamorphosis.

The last fact I mentioned—the sterility of the blood and
tissues—is denied by Mr. Tait, who says "the germs exist al-
ready in the blood and elsewhere, and are ever present, accord-
ing to the best authorites." The elaborate and carefully con-
ducted experiments of Hauser,[3] Watson Cheyne[4] and others
completely contradict this statement, which is really the founda-
tion of Mr. Tait's argument. As we have seen, the evidence that
germs cause fermentation is undeniable and it is equally true
that germs can be excluded from wounds by antiseptic precau-
tions or can with less certainty be destroyed after they have
gained access. This statement rests on the one hand upon
microscopical evidence (microbes being demonstrably absent
from the discharges of properly sterilized wounds and as con-
stantly present in suppurating or sloughing wounds); and on
the other hand upon a mass of clinical testimony familiar to
every member of the profession. A portion of this testimony,
in spite of its triteness, it is necessary to recapitulate in order
to complete the argument: The germ theory of fermentation

[3] Archiv. f. Experiment, Pathologie and Pharmacol., bd. 20 p. 162.

[4] ritish Med. lour, March 3, 10, 1888.

is undisputed; fermentation in wounds can therefore be pre-
vented by the exclusion of germs; it has been shown microscop-
ically that these can be kept out (asepsis) or can be destroyed
(antisepsis); practically therefore it only remains to show the
effect upon patients with operative or other wounds of exclud-
ing or destroying germs to show the value or lack of value of
antisepsis and the antiseptic theory. By looking back a few
years to the very beginning of the employment of antiseptics
we can obtain the most striking and comvincing evidence of
the effect of treatment directed almost exclusively, though then
very imperfectly, against the introduction of bacteria.

The record of the work of Prof. Lister may well begin
our series of examples: In Glasgow, in 1864, 1865, and 1866,
Mr. Lister's mortality in a series of operations of all sorts was
45.7%, largely from septic diseases. About this time he be-
began to employ, gradually, some antiseptic methods in his
treatment of wounds and during operations. In 1867, 1868 and
1869, his mortality fell to 15%. At Edinburgh, having greatly
improved the details of his system, we find that from 1871 to
1877 he treated 553 grave surgical cases with a mortality from
septic disease of only .36%, a diminution in the death-rate
which, when we remember that these different results were ob-
tained by the same man operating upon the same class of pa-
tients and for the same injuries or diseases, is so striking as
to be in itself conclusive. Still later, an opportunity was af-
forded to compare Mr. Lister's results with those of a col-
league, Mr. Spence, working in the same hospital, but declin-
ing to employ antiseptic methods. The total results of their
major operations showed that Mr. Spence lost just about three
patients where Mr. Lister lost one, while the deaths from in-
fective diseases were 2.4% among Spence's cases and one-third
of 1% or 8 times less among those of Mr. Lister. When we
turn to the work of other surgeons we find evidence, if possible,
still more conclusive of the value of these methods. Nuss
baum has shown that during forty years in his clinic under his
own direction as well as that of his predecessors, among whom
was Stromeyer, the deaths from wound diseases were so com-
mon that patients with even the slightest injuries often suc-
cumbed to them; that erysipelas and abscesses were matters of

daily occurrence; that 80% of all wounds and sores were at-
tacked with hospital gangrene, and that nearly all patients
with compound fractures died; and he states that immediately
upon the introduction of the antiseptic system, all these dis-
eases vanished; and healing by first intention, previously almost
unheard of in his service, became the rule instead of the ex-
ception. Prof. Volkmann, in an address before the Inter-
national Medical Congress which met in London in 1881, testi-
fied strongly and clearly to the results obtained in his own
practice, selecting two subjects especially, compound fractures
and major amputations, as evidence of the value in his hands
of the antiseptic method.   He said that the mortality after
compound fracture had, during the long labors of the sur-
geons who preceded him as well as during his own, reached the
sad height of 40%. Immediately before he adopted the anti-
septic method of treating wounds, his last twelve patients with
compound fracture had all died of pyæmia or septicæmia.
From that time up to the period at which he delivered this
address he had treated 135 compound fractures without losing
a single patient from either of these wound diseases; 133 were
cured; 2 died, one of fatty embolism of the lungs during the
first few hours, and one, a drunkard, of delirium tremens. As
to the amputations, he asserted that he now cured each year
with the antiseptic method more cases of amputation of the
thigh, for example, than during all the rest of his labors
before the introduction of the method. In an article on the
treatment of compound fractures, Prof. Dennis, of New
York, has compiled further evidence in this same direction. In
the Pennsylvania Hospital, between the years 1839 and 1851,
there were treated 116 cases of compound fracture of the leg
and thigh; excluding those cases requiring amputation there
were 51 deaths, a mortality of 45%. In the New York Hospi-
tal, during the same period, there were treated 126 cases of
compound fracture of the leg and thigh; excluding amputations
there were 61 deaths, a mortality of 48%. From 1860 to 1876
there were reported from the surgical clinics of Vienna and
Zurich by Billroth, 180 cases of compound fractures; excluding
amputations there was a mortality of 41% from septic disease.
In the Obuchow Hospital Reports of St. Petersburgh 106

cases of compound fracture gave a mortality of 68 %. In Guy's Hospital, from 1841 to 1861, there were reported 208 cases of compound fracture with 50 deaths, a mortality of 26 %. After the introduction of antisepsis this death-rate immediately fell to 4 % from an average of 40 to 50 %, and in this article of Dr. Dennis, in which he reports 516 cases of compound fractures, there was no record of death from septic trouble in any fracture of the extremities, which was the class of injuries included in the above statements. I might easily multiply such evidence as this a thousand-fold, but it seems unnecessary to repeat what has long been so familiar. And yet it is upon this evidence, which I have endeavored to condense, that the antiseptic theory rests. The facts and figures could easily be replaced by newer statistical matter but I have selected these for the very reason that they show better than more recent experiences the wonderful changes wrought solely by the employment of antiseptics under circumstances otherwise unaltered— drainage having been previously used, the amount of "pabulum" in the wounds remaining the same, the operators and surroundings being just as in the days of gangrene and pyæmia. Mr. Tait endeavors to break the chain of reasoning by saying, 1., that the germs are everywhere and cannot be got rid of— a misstatement—and 2., that the presence or absence of sepsis depends on the presence or absence of "pabulum" *i. e.*, dead organic matter, blood clot, serum, etc. It has been one of the axioms of antiseptic surgery from the beginning that scrupulous attention should be paid to hæmostasis and to drainage. No one has taught this more earnestly than Lister and his followers, and Tait's adoption of it as *his* "view" is evidence of his ignorance of the work of others. To be sure he says that Kœberle first taught him drainage in 1875, and gives due and deserved credit to Chassaignac for his work in this direction, but English and American surgeons have employed drainage fully and carefully since the early part of this century and Syme (afterwards Lister's father-in-law) in 1826, made the importance of providing a free escape for the discharges from wounds the subject of one of his most important papers. It is easy to say that if you have nothing to decompose there will be no decomposition, for that is what it amounts to.

"Get out all decomposable matter" he says, "and you can let the germs in freely," but in practical surgery this is by no means always possible. It is really to be regretted that Mr. Tait has not had an opportunity to see some general surgery, and particularly to follow Lister's practice at King's College Hospital. I am curious to know how he would interpret a case which I saw there in 1888 and described as follows, in a letter to *The Medical News*: It was a case of operation upon a fractured patella with elongation of the quadriceps by Cameron's method, in which there had been muscular spasm followed by extensive oozing from the cut surfaces. "A large clot formed, producing considerable tension, necessitating the removal of the stitches, and causing at two points a slight separation of the edges of the wound. I watched this for ten days, and instead of the flush, the suppuration, the elevation of temperature and the alarming symptoms which would usually follow such hæmorrhage into and about a great joint, the patient and the limb both remained perfectly passive, with absolutely no sign of either local or constitutional irritation, while the clot itself gradually contracted and the knee resumed its normal outline. During all this time there was literally not one drop of pus and not a trace of offensive odor. A severer test of Prof. Lister's antiseptic methods could hardly be devised or imagined."

There was no lack of "pabulum" here, but it gave rise to no evil effects, while on the other hand I am sure that there is not a practical surgeon in the world to-day, no matter how "humble" or "unscientific," who doesn't know what the result would have been if the germs had been "let in freely." The numerous successful cases of Schede's method of utilizing blood-clot in the filling of bone cavities are similar arguments and of a most convincing kind.

Ignorance of general surgery and highly specialized experience offer the only explanation of such astounding statements.

Mr. Tait deals habitually with a membrane, the peritoneum, which has a remarkable power of self-protection. Microbes gaining access to the abdominal cavity are exposed to de-

struction either by the serum which it copiously exudes, or by a possible phagocytic action of its enormous numbers of endo-thelial cells, or by both. I have thought, too, that possibly the extraordinary cases of cure of peritoneal tuberculosis after simple laparotomy and flushing of the abdominal cavity were due to the stimulation of the membrane (through removal of pressure or through contact with the irrigating fluid) to greater exudation and of its cells to greater anti-bacteric activity. It is merely a supposition, but seems as reasonable as any of the explanations I have heard offered. At any rate these prop-erties are well known, and if one could anywhere in the body depend on the restriction of the amount of "pabulum" rather than on the exclusion of the germs it would be here.

Mr. Tait, after contemptuously discarding *all* surgical theo-ries, including that of antisepsis ventures upon one of his own. He thinks the phenomena of sepsis due to the "dose" of dead tissue or "pabulum," and of the poison resulting from its de-composition and with a momentary forgetfulness of his "hu-mility" he actually advances this as an original "working hy-pothesis." It would sound very much to the general surgeon as if Mr. Tait had never heard of sapræmia, which is described by a "Listerian"[5] as follows: "Sapræmia or putrid intoxica-tion represents that form of septicæmia in which a preformed toxic agent is injected into the circulation and in which the maximum symptoms are reached as soon as the poison has become mixed with the blood. This form of sepsis may be **caused by any microbe, otherwise harmless, or with only slight pathogenic properties, as the bacillus of putrefaction, which** causes putrefaction in any dead tissue as, for instance, a blood clot or contused tissue; and the symptoms arise as the pto-maines are absorbed, and are appropriate to the amount ab-sorbed, and subside with the cessation of absorption and their elimination through some of the excretory organs."

Mr. Tait's remarks against dosage are further evidences of his ignorance of Listerian work and teachings. He says: "With the Listerians one germ is as good as a thousand." I suppose it is safe to class Mr. Watson Cheyne, whom I have

[5] W. Cheyne.

just quoted, as a "Listerian." Indeed, he has for years been
Lister's assistant and authorized mouth piece. In Mr.
Cheyne's lectures on "Suppuration and Septic Diseases"[6] he
not only asserted but proved experimentally that the number
of bacteria introduced modified greatly the intensity of the
symptoms and even the character of the disease. He ex-
perimented with cultivations of Hauser's *proteus vulgaris*,
finding that one-tenth of a cubic centimetre caused immediate
death; one-fortieth of a cubic centimetre caused death in six
to eight weeks; smaller doses produced no effect. Similar
observations have been made by Passet,[7] Pawlousky[8] and others
and are as well known as any in connection with antiseptic
surgery.

It is evident that what is original in Mr. Tait's "hypothesis"
is not true and that what *is* true in it is not original.

2. THE PREVAILING ANTISEPTIC METHODS.—It seems ap-
parent at any rate that, to put it mildly, Mr. Tait is not a safe
or reliable authority on the general subject of surgical anti-
sepsis, but towards the end of his paper he ventures on a
specific fling at Lister's last surgical dressing. After asserting
that "Listerism" is "as dead as Julius Cæsar," he adds: "The
mischief probably is not at an end, for we hear that the last
phase of this astonishing craze is that wounds are to be dressed
with still a new contrivance, one as deadly and dangerous as
anything that can well be imagined—a double cyanide." I
am especially interested in replying to this statement for the
reason that, owing to the kindness of Sir Joseph Lister (who
during the summer of 1889 gave me confidentially the various
formulæ which he was using and supplied me with the ma-
terials from his own manufacturers of gauze and chemicals), I
was the first surgeon in this country to employ the dressing
in question and because I now have a series of cases in which
it has been used, large enough to justify publication. The
history of the steps which led up to the employment of this

[6]Brit. Med. Jour., March, 1888.

[7]Monatshefte f. Prakt, Dermatol., B. 6, No. 10. 1887.

[8]Centralblatt f. Chirurgie, No. 48, 1887.

material must be briefly mentioned both to explain its selection and in reply to the charge of "perpetual shifting."

The aim of the surgeon after every operative wound is, of course, to secure union by first intention. Any persistent irritation is a source of trouble in wounds, and the different antiseptics which have been employed have not been free from the charge of contributing to the occurrence of excessive inflammation by their own irritant action. The typical antiseptic must, therefore, be as nearly as possible devoid of irritating properties. It must be germicidal—that is, it must possess the power of destroying the micro-organisms. It must have an inhibitory power—that is, it must prevent the development of such organisms. It must be stable—that is, it must not disappear from the dressings after they are made, or after they are applied to the wound either by solution in the discharges or by volatilization.

In the old Listerian method carbolic acid was the antiseptic employed; but this had the disadvantage of volatility as well as great slowness of action as a germicide. Corrosive sublimate, which succeeded it, was stable and acted rapidly, but was exceedingly irritating, and, in addition, was precipitated by the albumen contained in the serum of the blood. This precipitate, it was discovered by Sir Joseph Lister, possessed powerful antiseptic properties, with much less power of producing irritation; and he, therefore, devised a form of antiseptic dressing called "the sero-sublimate gauze," which consisted of gauze charged with a solution of corrosive sublimate in the serum of the blood. This, however, was difficult to manufacture, and produced a harsh and non-absorbent material which was mechanically objectionable. It was succeeded, in his hands, by a combination of chloride of ammonium and bichloride of mercury, known as sal-alembroth, which, while much less irritating, was so exceedingly soluble in the blood serum that whenever the discharges from the wounds were copious it was washed out of the dressing, leaving them without antiseptic property. For these reasons Lister in time discarded this material and employed for a considerable period a gauze containing 3 or 4%, by weight, of the biniodide of mercury. This was less soluble, non-volatile, powerfully an-

tiseptic, but, again, extremely irritating, so that the least con-
tact with the skin produced an intense erythema, even going
on to vesication.

Lister was then led to look further for the ideal antiseptic
and finally to employ the double or mixed cyanide of mercury
and zinc, which he is now using.   Its most evident advantages
are, first, that it is non-volatile; next, that it is almost entirely
unirritating; thirdly, that it is insoluble in water and only
soluble in 3000 parts of blood serum, and, finally, that. while it
possesses but little germicidal value, its inhibiting power is so
high that a 1-1200 solution is sufficient to keep animal fluids
permanently free from putrefaction.   This combination of
qualities is possessed by no other of the antiseptics which
have been mentioned, and its deficiency in germicidal power
is easily remedied by including in the manufacture of the
gauze dressings which are impregnated with this material a
small percentage (1 in 4000) of sublimate, enough to be germi-
cidal, but too weak to be markedly irritating.   As I have said,
I was told the details of this method *confidentially* in the
summer of 1889.   The communication was confidential be-
cause, while Lister was experimenting with other dressings,
notably the sal-alembroth, the announcement had been made
by others that he was using them and they were extensively
employed at a time when he was quite unprepared for pub-
lication upon the subject.   Until November, 1889, therefore
I employed the double cyanide only in my private work, but
since that date, when Lister published his own conclusions on
the subject, have used it after nearly all my operations at
the University Hospital.   I present herewith in tabulated form
the results of the most important of these operations. ex-
clusive of dozens of minor cases which, while as a matter of
fact they often test severely the efficacy of any surgical dress-
ing, might be expected to get well under almost any form of
treatment.

I have grouped the cases roughly and have avoided un-
necessary detail for the sake of economy of space, the main
object in publishing them now being to establish the effi-
ciency of the double cyanide dressing and its freedom from
dangerous qualities.

TABLE OF SURGICAL CASES TREATED SINCE BEGINNING THE USE OF THE
DOUBLE CYANIDE GAUZE.—September, 1889 to December, 1890.

No. of Cases. Group.	Operations.	Memoranda.	Results.
1 13	Removal of cervical glands for tuberculous adenitis.	Wounds varied in length from two to six inches; in five cases, the dissection was most extensive, being carried along the œsophageal line; in four caseation and suppuration already existed	Except in the suppurating cases, union by first intention along the whole length of the wound. Drainage tube usually employed, but withdrawn during first two or three days. Fever rarely 100° after second day. No deaths.
2	Trephining of cranium.		
3	For compound fracture.	Wounds already infected by vulnerating body and by dirty fingers; careful sterilization by 1:500 sublimate.	Union of scalp wounds by first intention, no pus, no fever, no deaths.
4	For epilepsy.	In every case operation performed on account of history of traumatism.	In three cases union by first intention; one death from suppression of urine and uræmia in an old alcoholic.
3	Abdominal section.		
8	For removal of uterine appendages.	In every case 1:10000 bichloride solution was used for hands and sponges and when required for irrigation. Tube used in three cases.	Union by first intention except in two of the tube cases in which stitch abscess occurred; no deaths
4	For intestinal obstruction.	In two cases there was general purulent peritonitis and great distention. The obstruction in all four cases was from bands.	In two union by first intention and recovery; in the others death with in first 24 hours.
4	For peri-typhlitic abscess.	In two removal of vermiform appendix; in two evacuation of abscess and use of drainage tube.	One death in 24 hours, probably from ignorance of nurse, who neglected the drainage tube. In others rapid recovery without fever or other alarming symptoms.
1	For removal of tumors of abdominal wall & cure of ventral hernia.	Operation very tedious and prolonged involving much handling of tissues. Wound brought together by sutures *en etages*. Patient old and infirm.	Extensive "aseptic suppuration," *i e.*, without fever, pain or other symptoms thought to be due to traumatism to the thick layer of subcutaneous fat. Recovery with good, firm cicatrix.
4	Hypogastric section and cystotomy.		
1	For exploration.	No satisfactory explanation found for violent and persistent vesical symptoms, which had lasted for 29 years.	Rapid healing, no suppuration.
4	For removal of calculus.	Three stones weighing over two ounces. One small oxalate calculus.	All recovered without suppuration.

TABLE.—Continued.

Group.	No. of Cases.	Operations.	Memoranda.	Results.
4	1	For prostatectomy.	Very extensive operation, removal of large portions of the prostate.	Death on eighth day from uræmia and suppression of urine. Kidneys almost completely disorganized.
	1	For exploration and drainage.	An enormous prostate with absolute retention. Patient old and feeble.	Lived a year in comparative comfort.
5	2	Excision of varicose long saphenous vein.	Veins extremely long and tortuous. Patient disabled Incisions 18 and 19½ inches in length.	Rapid union No suppuration.
6	14	Excision of breast with removal of axillary glands.	In all complete removal of breast, opening of axilla and removal of axillary glands	Not a single suppurative case. Average time of healing and discharge from hospital 11 days. Average number of full antiseptic dressings, three.
7	3	Arthrectomy of knee.	In all of them most extensive removal of synovial membrane ligaments, cartilages and osseous foci of disease. All tubercular.	In all rapid primary union of skin wound. In two persistent suppuration in track of drainage tube, but final healing. In one at this date (eight months after operation) re-opening of sinus. In others apparent cure.
8	1	Removal of foreign body from knee-joint.	A portion of a needle found partly within, partly without synovial cavity.	Primary union under first dressing.
9	3	Removal of superior maxilla.	All three cases of malignant tumors.	Primary union of skin incision; all recovered from the operation.
10	1	Removal of both superior maxillæ with a portion of the malar bone.	For osteoma of both maxillæ.	Primary union of skin. Entire recovery from the operation.
11	2	Removal of a portion of the inferior maxilla.	For osteo-sarcoma.	Primary union of skin. Prompt recovery.
12	2	Excision of elbow.		
		For tuberculous arthritis.	Patient had already undergone several operations upon other joints.	Union by first intention under two dressings except in track of drainage tube. Entire union in three weeks. All movements of elbow preserved.
		For bony ankylosis.	The anchylosis was the result of an old fracture; the arm was extended and useless.	Primary union throughout whole wound under two dressings; functional result excellent.

TABLE.—Continued.

Group.	No. of Cases.	Operations.	Memoranda.	Results.
13		Amputations.		
	8	Finger.	Six from lacerated wounds in crushing accident; two from result of felon.	All healed by first intention under one dressing.
	1	Forearm.	From tubercular arthritis of wrist and carpus.	Primary union under two dressings.
	1	Arm.	In old ununited fracture at the upper third.	Primary union.
	2	Foot.	One malignant tumor of foot, one for crush of foot, both Choparts.	One healed by first intention, Second recent.
	3	Leg.	All for railroad injury.	Primary union in all.
	2	Thigh.	One for malignant growth of lower end of femur. One for tubercular osteitis of knee.	In 1 antiseptic suppuration in track of drainage tube which was left in situ or an unnecessarily long time. Final healing. In other primary union under 2 dressings.
14		Radical cure of hernia.	All of these cases were strangulated, all were seen and operated on early. In the inguinal cases Barker's method was used; in the femoral a modification of that method.	All recovered from the operation. In two there were fever and suppuration along the track of the catgut drainage. In one there is already a return of the hernia. In the others the cure *seems* permanent.
	3	Inguinal.		
	2	Femoral.		
15	2	Parotid tumor.	Both cases were examples of tumors over the parotid originating in the lymphatic rather than true tumors of the parotid itself.	Primary union in one. In the other a little aseptic oozing for a week.
16	1	Osteotomy and re-fracture of bones of the forearm.	For angular deformity following badly treated fracture. Open wound.	Primary union under two dressings. Cure.
17	1	Myotomy of adductor, sartorius & tensor vaginæ femoris.	For contractures of long standing.	Primary union.
18		Removal of tumors.		
	11	From scalp.	In eight cases the operation was for the removal of sebaceous growths. In three, included here for convenience, a painful scar was excised for supposed traumatic epilepsy.	In every case there was primary union except (in three along the track of the drainage tubes. In no case was there fever or suppuration.
	3	From neck (exclusive of tuberculous glands).	Hydrocele of the neck; two malignant growths of neck.	

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TABLE.—Continued.

Group.	No. of Cases.	Operations.	Memoranda.	Results.
18	4	From back.	Three fatty tumors; one large cyst.	
	1	From thigh.	One large fatty tumor.	
	2	From tongue.	One cyst; one malignant growth.	
	2	From tonsils.	For hypertrophy.	There were no deaths.
19	1	Ligation of brachial at two points	For ruptured traumatic aneurism, old operation.	Some sloughing from pressure previous to operation. Slow healing afterward with aseptic suppuration. Case ran an afebrile course to entire recovery.
20		Sequestrotomy.	In these cases the cyanide gauze was used freely as packing and was found to work excellently well. As the bone cavities slowly granulated, the discharges remained sweet, and were serous rather than purulent.	Recovery in each case.
	2	Of femur.		
	2	Of tibia.		
	1	Of cranium.		
21		Ununited fracture	Both of these cases were operated on by wiring. In the former the implantation of sterilized bone was tried, but was not successful.	One failure. One recovery. No suppuration or fever in either case.
	1	Of humerus.		
	1	Of tibia.		
22		Abscess.	In all of these antiseptic irrigation with bichloride was used, and recently with peroxide of hydrogen, always followed by packing with either cyanide or iodoform gauze.	All recovered. Profuse suppuration ceased almost immediately and the cavities rapidly closed during a moderate serous oozing.
	6	Acute.		
	5	Chronic.		
	2	Of bone.		
23		Perineal section.	In all the retained catheter was used and the wound was treated in accordance with the antiseptic methods described in this paper. Cyanide gauze packing was employed when necessary.	Recovery in every case but one in which nephro-pyelitis probably occurred. Exploratory nephrotomy was recommended, but refused and the patient, a child, passed from under observation.
	3	Rupture of urethra.		

TABLE.—Continued.

Group.	No. of Cases.	Operations.	Memoranda.	Results.
23	2	False passage.		
	1	Traumatic stricture.		
24		Plastic operation.	Union by first intention in all except two, in which tension caused separation of line of flaps. In those union by granulation took place.	Recovery.
	1	To make upper lip		
	2	To make lower lip.		
	1	To remove epithelioma of cheek and lower lid.		
25		Anal and rectal operations.	In these cases either the cyanide or the iodoform gauze was used in packing.	Recovery in every case. Afebrile course. No suppuration.
	8	For fissure.		
	6	For hæmorrhoids.		
	10	For fistula.		
	1	For rectal fibroids.		
26		Compound fractures in which drainage and antiseptic dressings were used.	In these cases sterilized iodoform was used in addition to the gauze.	Recovery in every case. No fever. No suppuration, except in last case when the injury was crushing and the damage to tissues excessive.
	3	Skull (included under trephining.		
	1	Humerus.		
	1	Humerus & both bones and fore arm.		
	6	Tibia.		
	4	Both bones of leg.		
	3	Tarsus and metatarsus.		

It will be observed that there are but five deaths in this list, two of them due to pre-existent and chronic disease; the other three were abdominal cases, operated on with the patients almost *in extremis*, with swollen bellies, intestinal paresis, and in one case with suppurative peritonitis. The surgeon who has not lost such as these in spite of his best efforts and most careful application of antiseptic and operative methods has, indeed, been fortunate.

I can truthfully say that in the whole list there have not been six freely suppurating cases, and that there have been no cases of septic trouble and no deaths from any form of blood-poisoning.

The majority of these cases have been observed from beginning to end by sections of the University class, and have been under the daily care of my residents at the University Hospital. Of most of them I have elaborate clinical reports, made by members of the third year classes, and handed in to my assistants at the completion of the case.

Upon others I have operated in private for well known physicians. I am sure that all who have seen these cases, whether students or practitioners, will corroborate my statements both as to the harmlessness and the efficacy of the method in question.

I am glad to be able to give this positive testimony in favor of the latest Listerian method, which, while it may not be permanent (as there are yet many opportunities for improvement before the *ideal* dressing is reached), is obviously undeserving the epithets of "deadly and dangerous," applied to it by Mr. Tait, without, I will venture to say, his having taken the trouble to watch its effect in a single instance, to calculate the quantity of cyanide in a single dressing, to consider the improbability of absorption, or indeed to give the matter any serious consideration whatever. For an example of the unscientific spirit which Mr. Tait justly claims for himself, and for absence of the humility which he unjustly pretends to associate with it, as well as for absolute recklessness of statement, commend me to the paragraph I have quoted about the cyanide dressing.

I must not be understood in my eulogies of antisepsis as

meaning to depreciate efforts made to attain the surgeon's
ideal condition of operative wounds, *i. e.*, perfect asepsis.
There is no opposition between them. On the contrary, asepsis
is the outcome of antisepsis, but I must confess to grave
doubts of the efficacy of many of the means advocated to this
end, and of some of the testimony in relation to it. These
doubts are founded on a comparison between published re-
sults and observed cases in the hands of some eminent Eu-
ropean surgeons—the almost uniform effect upon my mind of
such opportunities of comparison having been a distinct loss
of confidence in the statistical reports. I saw, for example, a
series of cases of excision of the breast, with pigmented irrita-
ble scars, with suppuration, with dressings that were percepti-
bly stinking, shown to a distinguished surgical audience, the
operator and lecturer being a vigorous advocate of asepsis as
opposed to antisepsis, and having in his clinic elaborate ap-
paratus for the sterilization of dressings by steam heat under
pressure, admittedly the best of all the non-chemical sterilizing
methods yet discovered. These cases were in such marked
contrast to what I had read of the results obtained at this
clinic that the experience was a great shock to my faith in
current surgical literature, a shock from which it has scarcely
yet recovered.

It cannot be disputed that in the light of modern science the
operator has a two-fold duty, viz., to prevent the entrance of
living pathogenic microbes into the wound and at the same
time to preserve the vitality of the tissues themselves. We
have already spoken of the phagocytic theory of Metchnikoff[9],
and in addition we have learned through Waterhouse's exper-
iments[10] and through the clinical experience already spoken
of, of the anti-bacteric power of the peritoneum. Bouchard and
others have observed the destruction of bacilli by the spleen
and their elimination by the kidneys, as in typhoid fever.
Buchner and Lubarsch[11] have shown the bactericidal power of
blood-serum or of some substance such as the fibrin ferment

[9]Fortschritte der Medizin, Bd. 2, 1884, No. 17

[10]Virchow's Arch.. Bd. 119, heft 3, p. 342.

[11]Versammlung Deutsch Naturforsch und Aerzte, Heideiberg, 1889.

contained therein. We have abundant reason, therefore, to believe in a general antagonism between the body cells and the micro-organisms of disease, even if, with our friend, Dr. William Osler[12], we are compelled to consider the question of phagocytosis as still an open one. It follows that the theoretical propriety of non-interference with these tissues cannot be doubted, and Lister plainly admitted and accepted this new view when he said that the floating particles of the air having been shown to be less harmful than was supposed, we may possibly dispense with antiseptic washing and irrigation, "provided always that we can trust ourselves and our assistants to avoid the introduction into the wound of septic defile.nent from other than atmospheric sources."

When this method is adopted it is evident that all strong antiseptic solutions which might compromise the vitality of the tissues must be discarded; instruments, silk, ligatures, sponges, etc., must be sterilized by heat, hands must be washed clean in sterilized water (after previous chemical disinfection), and the same is true of the skin over the field of operation. If antiseptic solutions are used at all they must be very feeble— 1:60 carbolic for instruments (after previous sterilization by heat), 1:10,000 sublimate for sponges, etc.

In the meantime, however, while waiting for further improvement in this direction I have felt and still feel that it is safer in a large general clinic, with several assistants and with numbers of students actively participating in the operative work, to depend upon full antisepsis rather than upon asepsis, and I have in the cases above cited and in large numbers of others, not of enough importance to include in the table, employed the following methods, substantially based on those of Lister himself, as described to me in a private letter of last January. They represent, therefore, the latest views made public before the Berlin address.

I need not detain you with a description of the preparation of the gauze itself. This can be found in detail in *The Lancet* for November 9, 1889, and January 4, 1890.

Immediately over the wound is placed a portion of the cya-

[12]Medical News, April 13 and 20, 1889.

nide gauze, washed in a solution of carbolic acid to get rid
of the bichloride of mercury in the dressing in contact
with the wound. For this purpose one part of carbolic
acid to twenty of water is safer than any weaker solution.
A very pure acid should be used, because, if impure, it is not
completely dissolved, and the undissolved particles are need-
lessly irritating to the surgeon's hands When a dressing is
changed this piece of gauze is applied over the wound before
the surrounding parts are cleaned with the carbolic solution.
The carbolic acid soon flies off from the washed gauze, leav-
ing nothing in it in contact with the wound but the unirritat-
ing cyanide.

By proceeding in this way it is not necessary to use "protec-
tive." The amount of unwashed gauze to be applied
will depend upon the amount of discharge anticipated. In
the early stage of a wound, where we expect much sero-
sanguineous oozing, it is desirable to use a considerable mass,
say an inch in thickness, and extending on all sides be-
yond the wound. Further, it is well, where free discharge
may occur, to place over the dressing a piece of thin mackin-
tosh with the caoutchouc side (antiseptically washed) next the
dressing. This is for the purpose of preventing the discharge
from coming directly through the dressing. It should not, of
course, overlap the gauze, nor need it even extend to its edge.
When the part operated on is placed on a splint, as after resec-
tion of the knee, the padding of the splint is lined with such a
piece of mackintosh.

It is unnecessary to purify bandages or elastic bands that
are placed outside of dressings, but if a bandage is used in
the interior of a dressing, as in bandaging a stump next the
skin, it is purified sufficiently by soaking it thoroughly with a
solution of corrosive sublimate 1:2000. For purifying the skin
1:20 carbolic acid in 1:500 sublimate solution is used. The tow-
els placed around the seat of operation are wrung out of 1:2000
sublimate lotion, and this is also used for the sponges during
the operations. The carbolic solution is also used for purify-
ing the instruments before an operation. At the end of an
operation, before beginning to stitch, the wound may be
washed with 1:500 sublimate lotion, and irrigated with 1:4000
during the stitching.

But where a joint, such as the knee, is opened the use of the strong sublimate solution, which is seriously irritating to the synovial membrane should be avoided; and in that case it is better to irrigate through the whole operation with 1:4000. As to rendering wounds aseptic which have been infected, that is, speaking generally, a thing on which we can never reckon with absolute certainty; in recent wounds, like compound fractures, the chance of success is, of course, always greater the shorter the time that has elapsed after the infliction of the injury.

If the skin and wound are greasy, oil of turpentine is of great value for cleaning away the dirt, and the use of a nailbrush with carbolic and sublimate solutions, after the turpentine (or without it if there be no special occasion for its use), is very valuable. In many cases where septic sinuses are present, it is hopeless to try to extirpate the septic mischief; but very great advantage is gained by washing the cut surfaces in an operation under such circumstances with a solution of chloride of zinc, forty grains to the ounce of water. This is done once for all at the conclusion of the operation, and prevents putrefaction during the critical early days. The same solution is used where the wound communicates with a septic cavity, as after the removal of a portion of a tongue, or of a jaw; and under these circumstances it is also useful to apply iodoform to the cut surface after the chloride. In cases in which the septically infected part is of very limited extent, as, for example, where a suppurating strumous gland has discharged without an antiseptic dressing, complete disinfection may often be obtained by applying undiluted liquid carbolic acid, after scraping away the degenerated glandular or other tissue with a sharp spoon.

I have recently learned to value peroxide of hydrogen very highly as an antiseptic especially in suppurating cases and am using it more largely than ever before.

This address has already assumed an inordinate length on account of the necessity for free quotation, but I cannot conclude it without a protest against the tone of Mr. Tait's paper and against the personal virulence of its references to Lister. There is, unquestionably, room for legitimate differences of

opinion as to the treatment of operative wounds; there are many problems relating to the principles involved which are yet unsolved; the precise comparative value of the different factors, which taken together, have given modern surgery its scientific exactness, is yet to be determined; argument and discussion are not only excusable but highly desirable and, conducted in a proper spirit, could scarcely fail to be productive of great benefit to surgery and humanity. But this is not to be brought about by invective or by personal detraction. Mr. Tait discloses his real animus when he complains that for twelve years he has been "ignored" by Lister, and his controversial writings show that he probably belongs to that class of persons who feel far more deeply injured by neglect than by assault.

It is doubtless true that he and his work, carried on in a special line and under special conditions, have not in the consideration of the whole subject been elevated into the prominence which he thinks they deserve; but how many of us in this world are taken at our own valuation, either personally or professionally?

Lister's work since he took his first degree in 1852 has been of a character to command the respect and admiration of the scientific world. Receiving the first prizes in botany and anatomy when he passed the M. B. examination, he won the gold medal and the scholarship in surgery in the final examination. His papers on the minute anatomy of the skin, the physiology of the lacteal current, the contractility of the iris, the microscopic anatomy of involuntary muscular fibre, the relations of the inhibitory system to the visceral nerves, the regulation of arterial contraction by the nervous system, the early stages of inflammation, the coagulation of the blood, etc., stamped him at once as an original investigator of the first rank, and as one of his biographers says "would have sufficed to make his career memorable if he had never applied antiseptic measures to the treatment of disease." I have heard Prof. Louis Agassiz years ago and later Prof. Joseph Leidy say that, viewed from the standpoint of abstract science, his work had been of the very highest order and the appreciation of his labors by the best minds in our own profession

has been enthusiastic and almost universal. Nearly every great surgeon in the civilized world has put on record his admiration for Lister's teachings, his acceptance of the general principles involved and his sense of almost personal obligation to the author of the antiseptic theory.

That Mr. Tait should speak of such a man as having "lived in the clouds of his spray for the last twelve years," as "wanting in logic," having "crude notions of logical definition," making "illogical blunders," "falling away from his own faith," promulgating an "absolute and ludicrous logical error," etc., and should make a boast of having "laughed at" and "ridiculed" him and his doctrines and disciples, is, it seems to me, evidence of his unfitness by temperament or training (or from lack of the latter) for the serious discussion of broad surgical principles. I am quite sure that the vast majority of general surgeons will be found to have no sympathy with either his views or his manner of expressing them, and it is a relief to find that in his own special line there are operators of equal eminence who repudiate both. In an address on "Abdominal Surgery, Past and Present" recently delivered before the Medical Society of London, its President, Mr. J. Knowsley Thornton, said: "I am not ashamed still to use the spray and all the precautions which have advanced my results in ovariotomy to 1.88 % mortality (as against Bantock's 4 and Tait's 3.3 %) and I find increased practice and a steady adherence to methods which have yielded me good results in the past increase in like ratio my success in all abdominal operations. Every operator of prominence improved his results enormously as soon as he adopted Listerism; then having learnt how to be surgically clean, he has found for himself ways of attaining this end with more or less success by methods differing from those of Lister. The sum and substance of it all is, that if we had never had Lister to teach us true cleanliness, we should never have used antiseptics, flushings or drainage tubes to attain it. The great advance is due to the antiseptic system, the minor details are merely the different ways of attaining the same end—asepticity. Time alone will show what is worth retaining and what we may safely cast aside."

RUPTURE OF THE JOINT CAPSULE AND EXTENSIVE' CONTUSIONS AS CONTRA-INDICATIONS TO IMMEDIATE SUTURING OF FRACTURE OF THE PATELLA.

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IN discussing the subject of fracture of the patella in a former article by the writer, the following language was made use of:[1]

"The operation, in the hands of skilful and thoroughly competent surgeons, is destined to become shorn of all its dangers, both imaginary and real, as an immediate method of treatment; it will, without doubt, in the not very far future, supplant the uncertain and tedious means at the disposal of our forefathers, and in vogue, to a great extent, at the present day." It is with the view of modifying, to some extent, the views therein expressed, that I have brought the matter forward again, further experience in the treatment of fracture of this bone having served to convince me that arthrotomy and suture as an immediate method of treatment, in some cases at least, is fraught with considerable peril, both to the life and limb of the patient.

During the past eight years I have performed the operation of suturing fracture of the patella 13 times. My first case perished from carbolic acid poisoning, the patient, as was ascertained by the post-mortem examination, being the subject of chronic diffused nephritis. The fracture was complicated by a hæmarthrosis, and the operation of arthrotomy was undertaken for the purpose of securing the injured vessel, as a

[1]ANNALS OF SURGERY, vol. v., No. 6, June, 1887, p. 518.

final resort, after failure of the usual measures of treatment,
and recurrence of the hæmorrhage. Fortunately for my fu-
ture efforts in this direction, the death was due to an over-
zealous application of the antiseptic principle, rather than from
the failure of a well and judiciously applied aseptic effort, else
I should not have ventured to repeat what I believe to be an
operation entirely justifiable and proper, under proper condi-
tions and within certain limits.

Of these 13 fractures of the patella treated by suturing, 2
occurred simultaneously in the same individual, and resulted
from a fall from an elevated railroad structure. The right pa-
tella was broken into four, and the left into three fragments.
The ambulance surgeon had applied a bandage to both knees,
previous to bringing him into the hospital, and these were per-
mitted to remain until I saw the patient, seven hours later. At
this time there was no effusion into either of the joints, and
both patellæ were wired at once. In spite of the most rigid
asepsis, extensive suppuration took place in both thighs, the
joints which had been accurately closed by a separate suture,
and which closed at once, being the last to become infected.
Extensive incisions, which gave vent to broken-down blood
clot and sloughing cellular tissue, as well as considerable pus,
were made, and it was only after a prolonged and dangerous
suppurative process, during which the patient was placed in
the greatest possible peril, that he was saved from what seemed
a possibility of double amputation and perhaps death. The
region in and above the internal condyles was primarily, but
the joints finally became infected. He left the hospital
with fair motion in one joint, and almost complete fibrous an-
chylosis in the other. One especially well-marked feature in
this case was the occurrence of extensive ecchymosis of both
thighs, which became plainly visible about the seventh day
following the accident, which extended well toward the brim
of the pelvis and upon the buttocks.

A second case, that of a painter, who fell from a step lad-
der, followed an almost precisely similar course. This injury
also resulted from the application of direct violence. The
primary dressing applied by the ambulance surgeon, consist-
ing of a back splint and rather firm bandage, was permitted to

remain in place for several hours, at the end of which time they were removed, when it was observed that a remarkably slight amount of effusion was present in the joint. Arthrotomy and suture were performed, but in spite of every precaution extensive suppuration took place, and it was only after persistent opening up and drainage of the structures of the thigh that the case was finally brought to a safe termination.

The third case was that of a man who had received a smart blow upon the anterior surface of the knee-joint from the kick of a vicious animal. No bandage was applied to this case, but a very slight amount of effusion was observed to have taken place in the knee-joint. Arthrotomy and suture were performed eight hours later. Suppuration occurred along the vastus internus muscle, and early and free incision only sufficed to save the limb.

The joint in this case did not become invaded until comparatively late, the inflammation and suppuration in its incipiency being purely extra-articular, and in some respects it fared much better than the others, yet it became a source of much anxiety to me uutil it was finally dismissed with a useful limb.

A fourth case, that of a very muscular laborer, received the injury in the classical manner, *i. e.*, by muscular violence. During the night following the accident the effusion, which had been at first considerable, disappeared almost entirely under the influence of pressure exerted by a Martin's elastic bandage. The joint was opened the next day, and the fragments sutured by a silk-worm gut suture. On the third day a rise of temperature indicated some disturbance of the injured parts. This was found to consist in extensive suppuration of the thigh which necessitated the institution of prompt measures of relief. Repeated incisions and thorough drainage were followed by improvement in the patient's condition, and in final cure.

Here, as in the preceding cases, the joint itself was the last to become infected; the thigh, particularly upon its inner aspect, was the site of extensive ecchymosis, as it was at this point likewise that the suppurative process had its origin and expended its greatest force.

A fifth case, that of a horse-shoer, was the result of direct

violence, the patient having received the calk of a horse's
shoe directly upon the anterior surface of the right patella by
a kick of the animal.   The fracture was oblique, and from this
circumstance the fractured bone was not wired, but catgut su-
tures were applied to the capsule to approximate the edges of
the latter, as well as to steady the fragments.   Infection took
place within the joint itself, and the latter was re-opened, irri-
gated and treated by tamponing with iodoform gauze.   Fol-
lowing this course of treatment the case finally came to a satis-
factory conclusion, although an almost completely anchylosed
joint resulted.

In this case no infection of the thigh took place, although
the joint infection was complete and decided.   This, however,
was due, not to any want of care in the operation, nor to a
failure to properly appreciate the conditions present, but
rather to the fact that infection had occurred before he fell
into the surgeon's hands.   In pre-antiseptic times this limb
would have been condemned for amputation at once.

To offset these unfortunate experiences I have to add three
cases in which the primary suture was applied in simple un-
complicated fractures of the patella with most brilliant success.
In two of these the effusion was copious and rapid, and the
provisional dressing applied by the ambulance surgeon was
removed within the first few hours after entering the hospital,
owing to the agonizing pain incident to the increasing pressure
of the bandage as the swelling went on.   In a third case,
treated in private practice, there had likewise been considera-
ble effusion immediately following the accident, but this had
in a measure subsided under evaporating lotions when I was
requested to see him by his family physician on the fifth day.
In all of these cases an uncomplicated and uneventful course
of healing followed arthrotomy and the application of the su-
ture to the fragments.   The injuries were the result of muscu-
lar violence, and there was a marked absence of contusion
and ecchymosis in the limbs.

The following case still further illustrates the fact that in-
fection, occurring in the neighborhood of the joint itself, need
not necessarily involve the deep structures of the thigh, par-
ticularly in the plane of muscular tissue which constitutes the
vasti:

An adult woman was brought into the hospital with a rupture of the ligamentous connecting band between the fragments of a patella which had been originally fractured more than twenty years before. A considerable amount of effusion had occurred within the joint, which did not disappear upon the application of a firm bandage. On the fifth day arthrotomy and suture of the fragments were done. A plate of hard rubber was placed upon the anterior surface of the patella, after suturing the operation wound, and the ends of the wire suture twisted over this. A slight point of ulceration occurred beneath this plate of hard rubber, which became infected, and the subcutaneous cellular tissue about the joint became the site of extensive suppuration. The deeper planes and intermuscular spaces of the thigh, however, escaped entirely, and at no time was there any considerable elevation of temperature nor the grave constitutional disturbances which was such a pronounced feature in the cases included in the first series.

As illustrative of the comparatively slight danger of opening the joint and securing the fragments by suture in cases in which a sufficient time has been allowed to elapse to bring the latter within the category of secondary operations, the following is reported:

An ex-cavalryman had been discharged from the United States service on account of a fracture of the patella and the functional disability resulting therefrom. An accident, which produced a rupture of the ligamentous band of union between the fragments, occurred fourteen days prior to the time when he came under my observation. But very slight swelling had been present from the beginning, and a firm bandage had been applied continuously without discomfort. Upon the sixteenth day following the infliction of the injury the fragments were brought together, after opening the joint and dissecting away the old fibrous connecting band. A perfectly aseptic course followed, and the patient was dismissed with a useful limb.

In three subsequent cases of secondary suture, done at periods varying from six months to two years following the injury, in which the operation was undertaken for functional disability due to the existence of ligamentous union following fracture of the patella, equally brilliant results followed.

The following case previously reported[2] shows the importance of attempting to secure thorough antisepsis from the very beginning:

An insane woman jumped from a second-story window to the sidewalk, striking her right knee-joint and suffering a compound fracture of the patella. She was cared for immediately, the wound being thoroughly irrigated and protected by an antiseptic dressing. I applied the suture at once and no infection followed, although the upper fragment subsequently became necrosed, owing to the violence which it had sustained, and was removed. The patient was discharged from the hospital with a useful limb, the movements of which subsequently became normal in every respect. In this case, although the injury resulted from direct violence, there were no contusions other than that directly upon the anterior surface of the patella, the surrounding parts having entirely escaped.

In reviewing these cases, one is struck by these points: 1. The persistency with which the cases which had been exposed to great violence developed infectious inflammatory complications. 2. The striking fact that in these cases the primary points of infection reached rather to the deep muscular structure of the thigh than to the knee-joint itself, and this latter only became infected subsequently. 3. The immunity of the structures of the thigh from infection when these were uninjured, even in the case in which direct infection of the joint itself occurred, and suppuration of the latter followed. 4. The fact that when excessive traumatism and infection were both absent, a remarkably rapid cure followed, with a perfectly useful limb. 5. The perfectly safe course which those cases pursued which were sutured as a secondary method of treatment. 6. The peculiar, and at the time to me unexplainable, fact that in all of the cases in which no distension of the joint cavity occurred, as well as those in which the effusion having taken place, the application of a firm elastic or other bandage resulted in the rapid disappearance of the effusion, prompt and decided infection with resulting abscess of the thigh followed, in spite of every care. 7. The immunity from septic

[2]Annals of Anatomy and Surgery, 1885, vol. 11, p. 246.

complications in those cases in which no amount of bandag-
ing that could be borne by the patient sufficed to prevent the
occurrence of effusion within the joint; or, the effusion having
occurred, led to its diminution.

I must confess that, at first sight, there would seem to be
presented in the cases first cited a rather startling set-back for
the operation of wiring the fractured patella, and I am willing
to admit that, in the particular class of cases to which they be-
long, there is a positive contra-indication to the performance
of the operation as a primary procedure. No surgeon, follow-
ing such experiences as these, would be considered other than
fool-hardy to attempt immediate suture in such cases. It
therefore behooves us to critically examine the anatomical
relations of parts involved in the injury where the traumatism
is severe and extensive, and there seek an explanation of the
untoward results just related.

The cavity of the knee-joint forms the largest synovial sac
in the body. It follows the capsular investment of the joint,
this latter being made up anteriorly by the quadriceps exten-
sor tendon, the ligamentum patellæ and the patella itself. It
forms a large cul-de-sac as it bulges upwards beneath the ex-
tensor tendon in front of the femur, this extending some dis-
tance beyond the line of the articular surface of the latter.
Even above the point to which the cul-de-sac reaches in the
thigh there frequently is found to exist a large bursa, inter-
posed between the tendon and the bone, and which communi-
cates directly with the cavity of the joint.

The vastus internus, together with the crureus, inasmuch as
they are practically but one muscle, constitute the smaller por-
tion of the great quadriceps extensor. It arises from nearly
the entire length of the internal, anterior and external sur-
faces of the shaft of the femur; its attachment is only limited
above by its aponeurotic connection with the lower part of the
line which extends from the inner side of the neck of the fe-
mur to the linea aspera. It is also attached to the entire length
of the linea aspera, at its inner side. This muscular plane, it
will therefore be seen, serves as a transverse partition, so to
speak, between the anterior and posterior structures of the
thigh for at least three-fourths of that portion of the bone

which lies below the attachments of the capsule of the coxo-femoral articulation.   The lower fourth of the anterior surface of the femur is separated from that portion of the vastus internus called the crureus by the intervention of the synovial membrane of the knee-joint. It will thus be seen that the cavity of the knee-joint is really continuous in an upward direction upon the anterior surface of the femur for one-fourth of the entire length of the latter, and terminates upon the plane of the attachment of the vastus internus.   The effect, therefore, of a rupture of this upper recess of the knee-joint would be to permit of the passage of serum and blood from the latter upon this muscular plane, and thence upward until the aponeurotic attachment at its upper limit is reached.   At this point the extravasated fluids would find their way to and upon the glutei muscles.

With these facts before us it is not difficult to understand why suppuration of the anterior and inner portion of the thigh should occur in primary suture of the fractured patella.   A sufficient explanation is to be found in the fact that there occurs an extravasation of the effused fluids, which follows immediately upon the receipt of the injury, into the spaces between the vastus internus and the bone, in those cases in which the upper recess of the joint cavity is ruptured. The opening of the knee-joint under these cirumstances is almost certain to produce suppuration in a locality in which it is almost impossible to accomplish complete disinfection, by opening up a direct route of infection into the depths of the thigh along the plane of the vastus internus muscle, between this muscle and the femur.   Following the course of the muscle downward, the infectious process finally reaches the patella and the wound itself, in spite of every care.   The application of the dressings and bandages would tend to further the extension of this infection by forcing the effused fluids from the joint cavity through the rent in the upper recess, instead of permitting them to escape through the drainage tubes placed in the joint for that purpose.   Even were the dressing omitted, the tendency would still be for the fluids effused into the joint subsequently to the operation and closure of the latter, to become extravasated into the space already invaded by the traumatism.

A striking proof of the occurrence of rupture of this upper recess of the synovial cavity, and the readiness with which effused fluids may pass beyond the limits of the joint itself and become extravasated along the muscular plane above alluded to, is occasionally seen in the rapidity with which these effusions may be made to disappear after severe injuries to the knee-joint, by the simple application of an elastic bandage. Writers have mentioned instances in which a single application of a rubber bandage has resulted in the total disappearance of the effusion in a few hours and a restoration of the normal appearance of the joint. In no other joint can this result be produced, nor yet in the knee-joint in cases in which the effusion is due to other causes; and there is no reason for believing that in this joint, pressure would hasten the resorption of the fluids in this extraordinarily rapid manner. As a matter of fact, resorption does not occur at all; what really happens is a forcing of the fluid from the cavity of the knee-joint, through a rupture of the latter at the point indicated, or elsewhere, and into the neighboring inter-muscular spaces. True, a distension of the upper recess may occur, in which no rupture has taken place, if the effusion in the cavity be not large; while the elastic bandage remains applied, the impression may be given that the effused fluids have undergone resorption. But these are not the cases in which such apparently brilliant results have been obtained, for it is found that upon removal of the rubber bandage the distension of the joint recurs. It is not to be denied that the application of the elastic bandage may be instrumental in producing resorption of the fluids both in the joint and upon the plane of the vastus internus muscle; that it occurs, however, other than by the usual and slow process, is open to doubt.

To Prof. Riedel, of Jena, we are indebted for the rational explanation of the occurrence of extensive and deep suppuration of the thigh following primary wiring in certain cases of fracture of the patella.[3] This observer had the misfortune to lose a patient upon the table during an attempt to suture the fragments, as a primary operation. An immediate examina-

[3]Centralblatt f. Chirurgie, 1890, No. xii.

tion of the parts revealed the existence of two points of per-
foration of the upper recess of the joint, and an extensive hæm-
orrhage between the vastus muscle and the bone.   The im-
pression that the first case was but a clinical curiosity was dis-
pelled by the occurrence of a second case in the practice of
the same surgeon.   A male, æt. 54 years, had received a blow
upon the patella by being attacked by an ox, aud considerable
traumatism had been inflicted.   There was considerable swell-
ing of the thigh, which, when the man was received in the hos-
pital, eight days later, had extended to the pubis; later on,
this extended upon the outer side of the thigh and to the re-
gion of the glutei.   This was undoubtedly a case in which the
joint capsule had been ruptured and the subsequent hæmor-
rhage and effusion had found their way from the parts—the site
of the original injury—and had infiltrated themselves along one
of the muscular planes of the thigh. In this case the hæmorrhage
must have been considerable in amount, as is sometimes known
to occur, as witness my own first case here cited.

A large amount of extravasation and consequent swelling
of the thigh need not necessarily exist in these cases of rup-
ture of the upper recess of the knee-joint; indeed, the sur-
geon's attention would scarcely be attracted by any change
in the thigh itself.   But a condition which should never fail
to excite suspicion is to be found in the occurrence of but
slight swelling and distention of the joint capsule—or, this
having taken place, the fact that it has rapidly disappeared.
On the other hand, the increase of pain and distension upon
the application of a bandage would be an indication that the
joint cavity is still intact, and other indications being favora-
ble, the primary operation may be resorted to with compara-
tive safety.

In exceptional instances the extravasated fluids may find
their way to the popliteal space; but as the vasti have their
points of origin high up, so the hæmorrhage will appear at the
edge of the pelvis, for the reason that the spaces in the muscular
mass are more numerous here than in the compact structures
below.   The discoloration of the skin, due to the hæmorrhage
and extravasation, will first make its appearance upon the in-
ner side of the thigh; later on appearing at the outer side and

upon the pelvis, and in the course of time, reaching to the leg.

Experiments to determine the amount of force required to rupture this portion of the capsule of the knee-joint had been previously made by Riedel[1]. The result of these showed that 200 ccm. of fluid, under a pressure of from 3.5 to 4 metres, produced rupture of the upper recess, the limb being in the extended position. The experiments were made upon the cadavera of strong males. In a series of similar experiments by Schwartz[5], it was found that a pressure may be given to the fluid equal to a height of from 8 to 12 metres before rupture will occur. The discrepancy in these results is due to the fact that no account was taken of the differences existing between the cadavera of young children and aged persons upon the one hand, and those of strong individuals in middle life. In addition to this, it should be borne in mind in this connection, that the upper recess particularly is supported from without by the rigid condition of the muscles of the cadaver. In instances therefore in which rigor mortis is well marked, a resistance equal to that determined by Schwartz may be found to exist.

That this complication need necessarily be a result of the distension occurring after the fracture, is open to some doubt. There is reason for believing that it may be produced by the same violent muscular effort which is an etiological factor in the vast majority of cases of fracture of the bone.

These facts will enable us to explain the untoward results in those cases in which the symptoms pointed to the occurrence of this complication. In addition to this condition there is another positive counter-indication to the application of the suture to the fragments as an immediate method of treatment. I refer to occurrence of extensive and severe contusions in the neighborhood of the joint itself. It is a well known fact among surgeons that where structures have been the site of extensive injury, even though these may be highly organized, the lessened vitality of the part lessens its resistance to infection. The question whether such a condition as rigid and

[1]Deutsche Zeitschrift f. Chirurgie, 1880, xii.

[5]Quoted by Riedel, op. cit.

absolute asepsis in an open wound really exists or not has
been frequently discussed, and it is more than probable that
a typically aseptic wound is of rare occurrence. The ques-
tion is simply one of dosage, so far as the entrance of infec-
tious material is concerned, and the local condition of the
tissues themselves and their powers of resistance will fre-
quently turn the scale in favor of or against the patient, rather
than the efficiency of the germicides employed, or the activity
of the microbes which have run the gauntlet of the antiseptic
dressings. With every effort brought to bear to prevent in-
fection, an infinitesimal portion of the morbific agent may find
its way into structures which from their damaged condition
may be entirely powerless to resist noxious influences;
to say nothing of the fact that the increased heat, together
with the presence of a greater amount of fluid within the con-
nective tissue spaces and the opening up of these latter to a
greater or less extent, undoubtedly favors, not only the pri-
mary occurrence of infection, but the rapid spread thereof. It
therefore becomes a question for the surgeon to determine, in
each individual case, as to whether or not he should expose
his patient's tissues to even the slightest infection, in this
locality, when these may not be in the best possible condi-
tion to resist the same.

This brings us naturally to the consideration of the question
of the propriety of postponing the operative interference to a
period when it may become one of almost positive safety to the
patient. It will be scarcely claimed by even the most enthusiastic
advocate of the operation of suturing the fractured patella that
the procedure is urgently called for in the beginning of the
treatment. With the exception of those rare cases in which
arthrotomy is demanded because of the occurrence of an ex-
treme hæmarthrosis complicating the patella injury, as hap-
pened in my first case, there is no need of undue haste in in-
terfering. Fully a fortnight may be allowed to elapse, and
even longer, with the chances altogether in favor of serving
the patient's best interests by such delay, rather than adopt-
ing the opposite course and risking the life and limb of those
entrusted to our care by opening up and exposing tissues
whose condition is such as to suffer severely from a small dose

of infection, when on the other hand, by withholding our hand until these shall have so far recovered themselves as to resist a much larger dose.   The cases above detailed in which the operation was postponed from fourteen days upward, and in which the technique of operation, as well as the surroundings of the patient, were precisely the same, so far as it was possible to make them, as those in which the operation was performed as an immediate method of treatment, when compared with the latter are strikingly suggestive of the propriety of waiting.   It may be said, in answer to this, that it may be more difficult to obtain the patient's consent when the first effects of the injury have passed away, than when, in the first few hours, he is acutely suffering.   That this is true I am aware, and it has occurred to me to have just this experience; but I would prefer to enjoy the consciousness of having saved the patient the risk of death or mutilation, and depend upon my powers of perusasion to induce him to submit to an operation which beyond doubt, when performed at the proper time, will give him the best possible result with the mimimun of danger, than to adopt the opposite course, and rob myself of that comfort which the conviction that he has done his whole duty always brings to the surgical practitioner.

A NEW OPERATION FOR SPASMODIC WRY NECK. NAMELY, DIVISION OR EXSECTION OF THE NERVES SUPPLYING THE POSTERIOR ROTATOR MUSCLES OF THE HEAD.[1]

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ABOUT three years ago, in studying carefully a case of spasmodic torticollis with Dr. Mitchell, he asked me, in view of the implication of the posterior muscles of the neck which rotated the head, as well as of the Sterno-Cleido, whether it would not be possible to do an operation for dividing or excising their nerves, similar to neurotomy or neurectomy of the spinal accessory nerve. I made a number of careful dissections to determine the feasability of the operation, and as a result of it, I formulated the steps of an operation which I have repeatedly done to the cadaver, but only once have I had the opportunity of doing it on the living. That case, Dr. Dercum who kindly referred her to me at the Woman's hospital for operation, will report fully to the Society this evening.[2] I may add, that the only difficulty of the operation was the depth of the wound, which made it troublesome to get a good light, and, therefore, the mechanical steps of the operation were sometimes a little difficult. An electric light (which I did not then have) would have facilitated its steps very much.

The hemorrhage was quite free, but easily controllable; the drainage was perfect, and the recovery of the patient from the operation a speedy one. Dr. Dercum will report upon the results, so far as the disease is concerned.

[1] Read before the Philadelphia Neurological Society, October 27, 1890. For the discussion and report of the case alluded to, see the Journal of Nervous and Mental Diseases, December, 1889.

[2] Loc. cit.

(44)

The Anatomy of the Parts Involved in the Operation.

I. *Muscles.*—The chief posterior cervical muscles that rotate the head are the splenius capitis, the rectus capitis posticus major and the obliquus inferior, of which the last, though not the largest muscle, has the most favorable leverage. The splenius is supplied by the external branches of the posterior divisions of the second and third cervical nerves. The rectus capitis by the sub-occipital from the first cervical, and the obliquus inferior by the sub-occipital and a branch from the second cervical, before its division into its external and internal branches.

An important anatomical point in recognizing the muscles and the nerves is the sub-occipital triangle, formed by the rectus capitis posticus major and the obliquus superior and inferior. The two oblique muscles which form the superior and inferior border of the triangle run from the tip of the transverse process of the atlas to the spinous process of the axis, and to the occipital bone, respectively.

The rectus capitis posticus major, which forms the third or inner border of the sub-occipital triangle, arises from the spine of the axis, and is inserted into the inferior curved line of the occipital bone and the space between it and the foramen magnum.

From this triangle emerges the sub-occipital nerve, and in it the vertebral artery is seen, and, of course, is most carefully to be avoided. This, and the occipital artery just below the triangle are the only arteries of importance which are to be considered in the operation.

II. *Nerves.*—The nerves to be resected are the posterior divisions of the first three cervical nerves. The posterior division of the *first* cervical sub-occipital nerve supplies the rectus and the two oblique muscles. After escaping from the spinal canal, between the occipital bone and the posterior arch of the atlas, it enters the sub-occipital triangle. Its location in this triangle makes it easy of recognition.

The posterior division of the *second* cervical just before its bifurcation gives off a small filament to the inferior oblique. It then bifurcates into two branches, the internal and external. The small external branch supplies the splenius.

The larger internal branch (the occipitalis major) pierces the complexus about a half inch from the middle line of the back, and then enters the trapezius muscle.

This nerve, the occipitalis major, will be involved by the section of the posterior division of the second cervical before bifurcation, but, inasmuch as this is mostly a cutaneous nerve and supplies only the complexus muscle, the paralysis of which would be a matter of no importance, the whole posterior division of the second cervical may be divided close to its emergence from the spine, and prior to its bifurcation into its external and internal branches. An additional reason is, that the occipitalis major from its size is readily found, and serves as a guide, whereas the two branches of the second cervical to the inferior oblique and the splenius (the first arising before, and the second after the bifurcation of the posterior division into the internal and external branches) are difficult to find.

The posterior division of the *third* cervical is much smaller than either of the others, but it is easily found under the complexus about an inch below the occipitalis major. Just after its emergence from the spine, it divides into the internal branch which is cutaneous, and the external, which supplies the spenius and other muscles. It is best to divide the main trunk, as it is more easily found than its branches.

OPERATION.

First step.—The field of operation having been shaved and disinfected, make a transverse incision about a half an inch below the level of the lobule of the ear, from the middle line of the neck posteriorly, or even slightly overlapping the middle. This incision should be $2\frac{1}{2}$ to 3 inches long.

Second step.—Divide the trapezius transversely.

Third step.—Dissect up to the trapezius and find the occipitalis major nerve as it emerges from the complexus and enters the trapezius. In the complexus is an intra-muscular aponeurosis. The nerve emerges from the complexus at a point between this aponeurosis and the middle line, usually about a half inch below the incision, but sometimes higher up, and then

enters the trapezius. It is always a large nerve of the size of a stout piece of catgut, and it is easily found if sought for at the right place.

Fourth step.—Divide the complexus transversely at the level of the nerve. This division should be made by repeated small cuts, so as not to cut the nerve which is our guide, after which dissect the nerve still further down from the anterior surface of the complexus, where it arises from the posterior division of the second cervical. Cut, or better, exsect a portion of the posterior division before the occipitalis major arises from it, so as to catch the filament to the inferior oblique muscle. This divides the *second cervical.*

Fifth step.—Recognize the inferior oblique muscle by following the sub-occipital nerve towards the spine. The nerve passes immediately below the border of the muscle.

Sixth step.—Recognize the sub-occipital triangle formed by the two oblique muscles and the rectus capitis posticus major. In this triangle lies the sub-occipital close to the occiput. It should be traced down to the spine itself, and be divided, or better, exsected. This divides the *first cervical.*

Seventh step.—An inch lower down than the occipitalis major, and under the complexus, is the external branch of the posterior division of the third cervical to the splenius. When found, it is to be divided or exsected close to the bifurcation of the main trunk. This divides the *third cervical.*

A drainage tube and horse hairs are to be inserted, and as the patient lies on the back, although the wound is very deep, the condition is most favorable for good drainage. If desired, the posterior muscles can be united by buried sutures, independently of those in the skin. The after treatment is the same as for ordinary operations.

EDITORIAL ARTICLES.

MACEWEN ON THE CURE OF ANEURISM BY INDUCING THE FORMATION OF WHITE THROMBI WITHIN THE SAC.[1]

In an address delivered before the Midland Medical Society, Dr. Macewen remarks upon the methods of curing aneurism by acting directly upon the blood stream to bring about coagulation. Most investigators who have endeavored to effect direct occlusion of an aneurism by the introduction of foreign bodies into its sac, have aimed at producing such an effect upon the blood stream as to cause coagulation of the blood contained in the sac, and the formation of a red thrombus. Galvano-puncture, stuffing the sac with wire, horsehair or catgut, and acu-puncture have all been used at times successfully, although most of the cases have been unsuccessful.

A red thrombus, Dr. Macewen remarks, consists at an early stage of masses of fibrin enclosing red corpuscles and a few white ones, the whole saturated with serum. As the fibrin contracts this serum is exuded and the mass diminished in bulk, and although it may have filled the sac at first, it now ceases to do so, and the blood stream may be re established, especially in aneurisms with non-collapsable wall. This has happened in many instances where occlusion lasted some hours or even days, after which slight pulsation returned, the volume of blood passing through the aneurism ultimately becoming as great as before the formation of the red thrombus; shrinking continues in red thrombus for a considerable period, so that this result may occur several weeks after the apparent occlusion. After occlusion has occurred, the red thrombus, which is simply a mass devoid of vitality, undergoes one of several changes. (1) It may be acted upon in the same way as if

it were in a wound, leukocytes penetrating it, by which the thrombus is absorbed and replaced by fibrous tissue. This would be the most favorable termination for red thrombi within an aneurism, but it is seldom seen. (2) It may undergo red or yellow softening. The former is serious, not only from the conversion of the mass into reddish or grayish disintegrating pulp, but from the fact that some of this disintegrating material may find its way into the blood current and set up emboli; yellow softening is even worse, as there is here not a mere disintegration of the clot, but an intense inflammation of the walls of the vessel, ending in pus production, dependent, in all probability, on septic contamination. The wall of the vessel participates in the softening process, when the blood may burst into the surrounding tissues. The blood current may also carry portions of septic detritus into the circulation, causing septic infarctions; this form of softening may be guarded against by preventing septic matter being introduced from without, and by rendering aseptic, prior to operation on the aneurism, any sore, abscess or suppurating ear the patient may have. White thrombi are not liable to either of these forms of softening; the first could scarcely occur in them, while the second is preventable.

Pathological examinations at periods subsequent to partial or complete cure have shown that the sac, in the majority of these cases, contained white thrombi. Dr. Macewen rejects the commonly received opinion that these resulted from the organization of red thrombi, believing that in many cases the white thrombi were originally formed as such, although this circumstance was accidental, and not caused by the operator, nor from any effect upon the blood stream.

When the current of blood is unobstructed, white thrombi are prone to form in the interior of a vessel at a spot where irritation has been induced, and from which the endothelium has been removed. At such a point leukocytes, derived partly from the vessel wall, and mainly by segregation from the blood stream, become firmly adherent to the vessel. When this process has been initiated, it tends to grow by superimposed accretions, so that a partial thrombosis may proceed until complete occlusion occurs. The leukocytes, shortly after their deposition, disintegrate into a finely granular fibrin, which shrinks, but by

no means so greatly as does that of red thrombi.   When the shrink
ing is complete, the white thrombus chiefly consists of an inert body,
capable of, and subject to, further transformation.

The white thrombus is rapidly replaced by vascularized fibrous tis
sue, the granular fibrin originally deposited becoming absorbed and
taking no share in the new formation.   The first step in the process is
the infiltration of the vessel wall with the leucocytes derived from the
vasa vasorum and neighboring vessels.   These penetrate the throm
bus, becoming converted into formative cells which develop into
fibrous tissue abundantly supplied with blood vessels.   In this way a
thoroughly vascularized connective tissue blended with the vessel wall
is formed throughout.   The vessels of this newly formed fibrous tissue
are continuous with those of the vasa vasorum.

The deposition of white thrombi occurs so slowly that in large aneu-
rismal sacs it is, as a rule, many months before occlusion takes place.
The thinner the layers of white thrombi formed on the walls of the ves-
sels the more easily will its organization be effected;   therefore, the
slower the process—other things being æqual—the more surely will or-
ganization follow in its wake.

It is evident, then, that a thrombus formed by acting on the con-
tents of an aneurismal sac is different from one induced by acting on
its walls.   The introduction of foreign bodies into the sac of an aneu-
rism in which the blood is freely circulating, with the object of forming
red thrombi, is not the most certain way of   producing permanent oc-
clusion of the vessel.   White thrombi are more suitable for permanent
aneurismal occlusion under such circumstances.

A white thrombus may be secured in an aneurismal sac by irritating
the wall of the aneurism in such a way as to induce infiltration of the
parietes with leukocytes and a segregation of them from the blood
stream at the point of irritation.   The irritation ought to be just suf-
ficient to set up reparative exudation, and should not exceed it; if the
irritation be pushed to such an extent as to induce softening of the
vessel wall, not only would the object be frustrated, but the pressure
of blood from within might cause the aneurism to burst.

While a white thrombus developed at a single irritated point in the

wall of a vessel might develop sufficiently to occlude it, it is better to
provide many foci of thrombi.   This may be done either by producing
a uniform irritation over the whole inner surface, or by stimulating as
many points as possible.   It is also desirable to secure foci all over
the sac, because if a white thrombus were formed in one part of the
sac alone, it might be possible for the blood to be exerted all the more
on some other part of the sac not so protected, which might result very
seriously in case of a very thin wall,   For this reason, also, it is desir-
able, as far as possible, to ascertain the form and dimensions of the
sac before inducing plastic inflammation at any point in it.   While this
can readily be done from without in aneurisms of the extremities, in
many cases situated in the trunk and root of the neck, the form can
only be ascertained by investigation within the sac itself.   Happily,
the very instrument which is used in the treatment is excellently
adapted to furnish this very information.

The instrument employed is a pin of sufficient length to completely
transfix the aneurism and to permit of manipulation within it.   Its cal-
ibre ought to be as fine as possible, the strength being only sufficient
to penetrate the coat of the aneurism and the intervening tissues.   It
is cylindrical, tapers to a point like an ordinary sewing needle, and has
on the opposite end a somewhat rounded head.   As the coats of aneu-
rismal sacs vary in thickness, it is necessary for the pins to vary in cal-
ibre, since those which may pass readily through the walls of one sac
may not penetrate the thicker walls of another   They should also be
finely polished, not only to facilitate their introduction, but to assist in
rendering them aseptic.

The operation is preceded by careful cleansing and asepsis of the
skin over the aneurism.   The aseptic pin is then made to penetrate the
sac, and pass through its cavity until it comes in contact with the op-
posite side, and no farther.   Then irritation may be effected, either by
moving the pin over the surface of the inner wall, or by allowing the
impulse of the blood-current playing on the very thin pin to produce
the same result.   If the wall, penetrated by the pin, on introduction
be dense, the former method will be preferable, as the force of the
blood current will produce so feeble an action on the thin pin as to be

insufficient to move it to and fro, while it is firmly grasped by a dense wall. After acting thus for ten minutes at one part, the point of the pin, without being removed from the sac, ought to be shifted to another spot, and so on, until the greater portion of the internal surface oppo- site to the point of entrance has been acted upon. This should be done in a methodical manner. A single insertion of the pin through the aneurismal sac into its interior may be sufficient to enable the point of the instrument to come into contact with the greater part of its in- ternal surface, but in some cases puncture from various sides of the external wall may be necessary to reach portions of the tumor which can not be attacked from the first puncture. While the pin is in the aneurism the protruding portion is surrounded by a bit of aseptic gauze, dry, or moistened with an aseptic solution. When it is with- drawn from the aneurism, the part is covered with a moist antiseptic dressing; for this purpose Dr. Macewen prefers a watery solution of carbolic acid, and he keeps this dressing in place for several days.

It is questionable whether all the necessary advantages derivable from irritation of the sac wall could not be obtained by keeping the pin within the sac but a few hours. Yet its retention for twenty-four or thirty-six hours serves to produce a greater immediate effect; there is certainly danger in retaining it for more than forty-eight hours.

In case of a very large aneurism, several pins may be introduced from various points, always allowing a considerable interval to exist be- tween them, otherwise there might be too much damage to the vessel wall at one point. When the pin has been withdrawn, though there may be a little thickening of the tissues in the neighborhood, there will be either little or no diminution of the eccentric impulse. Occasion- ally it may be weeks before any distinct and tangible thickening of the coats can be observed; in other cases it may be discernable at a much earlier period, and, as a rule, distinct thickening of the coats is recog- nizable at an early period. It should also be remembered, especially in deep-seated aneuris.ns, that the thickening appreciable on the ex ternal surface of the sac through which the pin is passed, is much less, as a rule, than that on the part of the sac acted upon by the point of the pin, and, therefore, the one farthest away from the point of en- trance which is accessible to manipulation.

In some cases Dr. Macewen has repeated the irritation many times, at intervals of weeks, with a view to hastening the cure. And while there was apparent advantage after each, it is doubtful whether the formation of thrombi, once fairly started, was not going slowly on, in- dependent of this secondary interference. It is clear that the coats of the aneurism can not be reached by the pin after they have been cov- ered by a thick layer of white thrombi. The extremity of the pin must come in contact then with the dead thrombi alone. Were the previ- ous layers of thrombus vascularized, then the secondary introduction of the pin would be of service in coming in contact with living tissue, and setting up in it fresh irritation and fresh deposition of white thrombi.

In connection with the subject Dr. Macewen remarks that any method which would induce the occlusion of the sac by the formation of white thrombi and its consequent organization into living tissues, might be used, provided it evinced any superiority to this one. Such a one in particular would be a method which, while equally successful and easily applied, would do away with the necessity of opening the sac.

Four cases are detailed, in two of which the clinical results were ver- ified by a subsequent pathological examination.

1. The first was a case of thoracic aortic aneurism seen at an ad- vanced period when threatened by dyspnœa. The tumor distinctly pressed the trachea to the left and somewhat overlapped and flattened it. In this case treatment by ligature was contra-indicated on account of the danger of anæsthesia with a displaced and flattened trachea, while relief of the dyspnœa by tracheotomy would have been danger- ous in the extreme, on account of the developing aneurismal sac. Pins were, therefore, inserted on seven occasions, with a few days' interval between each. On several, the pin was placed in such a position that its point barely touched the internal wall, while it was left free to move to and fro by the influence of the blood; in this way a slight scratching of the wall resulted. Several times the pins were retained in the sac for twenty-four hours, and once for forty-eight hours. Considerable consolidation followed, and a speedy favorable result was anticipated,

but death from the dyspnœa unfortunately occurred a month later.

The autopsy showed that two thirds of the interior of the aneurism had been filled with a white, firm, laminated thrombus, which was greatest along the inside of the outer wall, along which the needles played; much thinner on the inner wall, through which the needles were merely inserted in order to gain the interior of the sac; and thinnest of all in a small cavity at the upper portion of the aneurism which extended behind the trachea, and to which no needle had been directed, as it was not known to exist during life. It was evident that had the deposition continued at the same rate, complete occlusion would have occurred within a few weeks. Moreover, the walls of the aneurism had become so thickened that tracheotomy might have been performed with entire safety and death prevented, had the condition been known.

2. The second case was an aneurism of the upper part of the right femoral, involving the external iliac, and measuring five inches in diameter. The aneurism was somewhat circular in form, and its anterior wall was very thin, at one point only the skin and a very thin sac appearing to intervene between the examining finger and the circulating blood. Treatment by ligature was contra-indicated by extensive arterial degeneration, and pressure was shown, by prolonged trial, to be useless.

After pressure had been applied to the common iliac artery until the pulsations in the sac had entirely ceased, a long steel pin was passed into the sac until it touched the internal surface of the opposite side. It was left in that position for ten minutes, when the pin was withdrawn somewhat and then directed to another part inside the sac, when, after the same interval, it was again shifted to another position. Twelve different parts of the sac were thus acted upon, the pin being left in contact with each of these places for ten minutes. At the expiration of two hours the pin was removed, pressure over the puncture being maintained for about five minutes. Fifteen minutes subsequently the pressure on the common iliac was slowly removed. Dr. Macewen then thought the wall of the sac was already firmer, but his assistants and the patient could see no change. Twelve hours later, the walls

felt firmer, and there was no doubt of the improvement. This thick-
ening of the coats became greater daily, the solidification occurring
five days after the insertion of the pin, the aneurismal sac then being
converted into a solid ball, which still moved with the arterial impulse,
but there was no eccentric pulsation. Contraction and solidification
continued from this time, the patient returning to his work, fully re-
stored, eight weeks later.

About a year subsequently to the obliteration of the aneurism he
died from carcinoma of the tongue. The autopsy showed a small aneu-
rism of the left femoral, which had been observed at the time of the
operations, and a large one of the aortic arch which had been sus-
pected, while all the larger vessels were found to be subject to calcare-
ous degeneration. The obliterated right femoral aneurism, instead of
measuring five inches in length and breadth, as it did before the opera-
tion, now measured but two inches in length and three quarters of an
inch in breadth. It presents a hard solid mass which, on section, is
seen to be composed of dense vascularized fibrous tissue. Histologi-
cally, it presents dense connective tissue interspersed with numerous
blood vessels.

3. The third case was an aneurism of the upper part of the abdomi-
nal aorta, which presented a marked prominence in front, being some-
what circular in form and measuring three inches in circumference.
By inflating the stomach and intestines with gas, it was discovered that
they lay below the tumor, a free surface of which presented externally.
The patient on three occasions was subjected to irritation of the in-
ternal coat of the sac, after each of which there was a notable thicken-
ing of the wall; the force of the pulsation diminished at the part and
the pain and discomfort greatly lessened. As the tumor lessened, the
stomach began to overlap it in front. In a month the sac had receded
to such an extent that it could not clearly be made out other than as
a hard mass, heaving with the aortic pulsations. At this period the
patient insisted upon returning to his work, although the cure was not
yet complete, and his move was regarded with great apprehension by
the operator. He continued to work as an engine driver, and was in
seeming good health when seen two years and a half later.

4. The fourth case was an intra-thoracic aneurism of the subclavian, accompanied by great swelling, pain, numbness and loss of power in the left arm. The tumor projected above the clavicle into the neck. The upper wall of the aneurism was very thin. An aseptic pin, five and one half inches in length, was introduced, and by it the form and dimensions of the sac were ascertained. It was found to be about four inches high and three inches wide. The pin was then permitted to remain in the cavity for about nine hours, its extremity being frequently changed from one part of the sac to another, its point on each occasion being left free to move over the surface of the sac as the force of the stream of blood in the interior might direct. This was repeated four times, with an interval of one to two weeks between them, a gradual thickening of the walls of the aneurism ensuing. This was marked, not only by the sensation communicated to the finger externally, but by the fact that on each occasion, upon attempting to introduce the pin, greater difficulty was experienced in penetrating the coats of the vessel; while, at the outset, a pin of very fine calibre was readily introduced through the sac wall, it required a much stouter and more rigid one to penetrate the sac during the last insertions.

The improvement consequent upon these insertions was so marked that they were discontinued for four months, during which time there was diminution in the œdematous swelling of the arm and subsidence of the pain. Subsequently there was much thickening in the aneurism and great diminution in the pulsation; it was not so near the surface, but still there was a doubt as to whether it was not eccentric; it might have been that the tumor was pushed upward with each aortic wave, and being dome-shaped, conveyed the sensation of an eccentric pulsation. On five subsequent occasions a pin was introduced, with the object of hastening the consolidation; on each of these, it was difficult to say what the internal dimensions of the cavity were, and during the last two of them it was doubtful if it entered any cavity; the walls were so thick that the pin could not be made to move to and fro as it formerly did; certainly, it never reached the opposite wall of the aneurism, and it was, therefore, questionable whether good was derived from its use. Accordingly, the treatment was discontinued.

From this time the tumor began to decrease in size, the œdema of the arm gradually disappeared, and the numbness and the tingling sensation soon followed. The pulsation of the radial also gradually diminished until they finally ceased. The power of the arm was gradually restored, and eight months after the first puncture the patient was in excellent health, with a hardness about a third the size of the original tumor, which could be felt by slipping the fingers somewhat behind the clavicle.

Dr. Macewen recapitulates as follows: Here are four cases of aneurism, one involving the innominate, one the left subclavian, one the abdominal aorta, and one the upper part of the femoral implicating the external iliac. Two of these have been absolutely cured by the induction of white thrombi within the sac. One was so greatly relieved that he was able to resume his work as a locomotive engine driver, and to continue it for at least two and a half years thereafter. One died after two months' treatment from asphyxia when the aneurism was two-thirds healed, and when complete consolidation was within a few weeks of consummation. In the large aneurism of the femoral and iliac the circulation within the vessel was arrested for two hours, during which time treatment was performed on the sac wall; consolidation resulted in five days, and he was cured in a month. The aortic and innominate aneurism was a month under treatment, and had pins inserted on seven occasions. The formation of thrombi occurred rapidly, and was more extensive than was known during the patient's life. The aneurism of the abdominal aorta was a month under treatment, but it was not cured, the consolidation being incomplete. The aneurism of the left subclavian had pins introduced on nine occasions, though it is questionable whether the last pin produced any effect, or whether they were needed; consolidation occurred within nine months, and the cure was completed within a year.

None of these patients had anæsthetics administered, and they suffered comparatively little pain during the operation. The slowness of the occlusion in the last case, though disadvantageous in some respects, had certain advantages valuable in the presence of advanced arterial disease. It enabled the collateral circulation to become fully

established in a very gradual manner before complete occlusion of the sac had occurred, and thus saved the collateral vessels from sudden dilatation by increased blood pressure. It protected the heart and blood vessels on the proximal side of the aneurism from the sudden strain which would otherwise have been thrown on them by ligature of the vessels or by sudden occlusion of the aneurism. Though the completion of the cure takes long in certain instances, the aneurism is not left unprotected during that period, as its coats have been lined by white thrombi, forming a firm barrier against further aneurismal extension.

It is probable that, besides acting locally on the aneurism, in addition attention to the general state of the individual may facilitate the formation of white thrombi. By placing him in good hygienic surroundings, by limiting or regulating his diet so as to produce an effect upon the leukocytes of the blood, by the administration of drugs and by keeping the patient in a state of rest—any or all of these may have an effect in hastening the desired result; these are some of the points still to be worked out. It is well, however, that the fact should be established that white thrombi may be induced simply by direct local action, without any aid from other directions. No doubt some cases will be found more suitable than others for this form of treatment; in some, the white thrombi will form more readily, in some more slowly— future experience will decide. Dr. Macewen trusts that this form of treatment will not be indiscriminately employed upon every case of enlarged aneurism, especially upon those which are beyond hope, otherwise the method will become discredited. The very simplicity of the treatment, the facility with which it may be carried out, without even the use of an anæsthetic, and with a comparatively limited anatomical knowledge, makes this word of caution necessary. The cases of uncomplicated aneurism must be few in which the introduction of an aseptic steel pin into the sac would be productive of harm; disastrous results would easily follow the introduction of a pin carrying septic matter with it.

The author is not irretrievably committed to his methods of performing the operation. The main point is the recognition of the fact that

every aneurism contains within itself a potential cure.   The method of calling it forth is but a secondary matter.

JAMES E. PILCHER.

KRECKE ON THE SURGICAL TREATMENT OF CIRCUMSCRIBED AND GENERAL PERITONITIS STARTING FROM THE VERMIFORM APPENDIX.[1]

The affection of the appendix, leading to peritonitis, is its perforation.   This produces diverse phenomena according as it occurs, suddenly or gradually.   When it develops very slowly the neighboring peritoneal surfaces have sufficient time to unite, and by the great tendency to such adhesions only a circumscribed peritonitis then results. When, however, the perforation is sudden and the material passes into the free abdominal cavity, general peritonitis is the unavoidable sequence.   But as the various types of peritonitis are more carefully distinguished it is found that that from perforation of the appendix differs from that following perforation of other portions of the intestine.   Almost without exception the patients have previously been in the enjoyment of perfect health.   As their physical powers are unimpaired they are in better condition to tolerate operative procedures than if exhausted by long sickness.   A further peculiarity is due to the anatomical relations of the appendix.   When there is a perforation in any part of the small intestine the continuous peristaltic suffices to distribute the intestinal contents over the whole peritoneum.   The vermiform can not make such large excursions as a loop of the small intestine, or even as the stomach, and hence at first the extruded material infects only adjacent parts of the peritoneum.   Besides it is evident that from this little appendix there can never come as much infectious material as from the gut itself.   The fact that at no other point in the abdomen does circumscript peritonitis so frequently occur as just here agrees with this view.   The until recently accepted treatment of vermiform perforation with opiates was based on these naturally favoring conditions.

[1]Dr. Krecke, Assistant at the Erlangen Clinic, in *Deutsche Zeitschrift f. Chirurgie,* 1890, bd., 30; hft· 4 and 5.

And nowhere are the two forms of peritonitis distinguished by Mikulicz (v. ANNALS, Oct., 1889, p 289-292) of greater practical sig-nificance than in diseases of the vermiform. Where the whole abdominal cavity is immediately flooded with intestinal contents there arises what he calls *diffuse septic peritonitis*.   Where, however, at first only the neighboring peritoneum is intected the resulting local exudation de-velops successively new also encapsulated collections of pus, hence his designation *progressive* (*progredient*) *fibropurulent peritonitis*.   As a third point distinguishing vermiform peritonitis it may be mentioned that its diagnosis can frequently be made with far greater certainty than that of any other form.   Besides the usual peritoneal symptoms, the pain at the start·as well as during the further course is often especially intense in the right iliac fossa; then if the patient be a child a diagnostic indication is given by the fact that in children these troubles very commonly start from the vermiform.

Of the three points, the last gives us with some assurance the seat of the perforation, while the other two are only theoretically of interest as indicating that operative interference has here far better promise of success than in perforation of other parts of the intestine.   However, any collection of cases with regard simply to favorable or unfavorable result can not settle the question of operation, as so much depends on the stage of the disease at the time.   The cases that have been operated not only in Germany but especially in America and in Eng-land are hence but briefly recapitulated.   Two successful cases oper-ated at Erlangen, in the summer of 1889 (one by Prot. Heineke, the other by Krecke) are very fully described.

CASE I.   A girl æt. 9 years.   For 3 weeks pain in abdomen, loss of appetite, diarrhœa.   For the last 3 days attacks also of pain spreading across the whole belly.   Slight ileo-cœcal dullness. Vomiting.   Some improvement for 2 days, then sudd n terrific pain in the ileo-cœcal region, spreading over the abdomen.   Great distension and tender-ness   No hepatic dullness.   Fever.   Collapse.   Slight improvement Operation the next day.   Incision through œdematous tissues, as for ligation of common iliac.   In opening the peritoneum a quantity of stinking putrid fluid mixed with gas was discharged.

The peritoneum was everywhere darkly injected and fibro-purulent-ly coated: intestinal loops much inflated. The thickened dark red vermiform showed anteriorly a nickle-sized perforation with gangren-ous border   This was doubly tied close to the cœcum, severed and extirpated.   In a loop of small intestine and in one of the large also, a $1\frac{1}{2}$ to 2 ctm. long opening was made for the discharge of contents, including gas, after which both were again closed with double rows of sutures.   Hasty wiping of peritoneum; no irrigation; reposition of bowel; moss-cushion dressing.   The patient now appeared dying, but in an hour had reacted.   For the next 8 days there was but slight fever and little secretion.   Then came a quantity of putrid secretion from a large cavity in the small pelvis.   In this cavity was found the open stump of the vermiform; this time it was carefully closed with a double row of sutures.   Deep in the cavity was found a hole in the peritoneum from which the vaginal wall could be reached; boric irrigation; iodo-form tampon.   Two days later another large quantity of putrid fluid was discharged, containing a pea-sized enterolith; irrigation with thymol.   Meanwhile the child was visibly loosing flesh and strength— excessive wasting, no appetite.   Just two weeks after the operation there was found a double perforation of a presenting loop of intestine. The increasing fæcal discharge soon necessitated repeated bathing daily.   Nearly two months after operation some general improvement in her condition first became noticeable, despite continued fever, sup-puration and fæcal discharge.   However, matters had so far mended in all respects that she was discharged about four months p. o.   There was still a suppurating sinus into the pelvis and limited fæcal mixture in the secretion.

CASE II.   Healthy boy, æt. 6 years.   Sudden bowel trouble (diar-rhœa, etc.) without pain.   Sudden syncope four days later, then ex-cessive pain in right side of belly with some distension.   Some dull-ness in right iliac fossa only. Operated two days later, as in case I. Discharge abundant of pus, but without fæces.   Vermiform perforated anteriorly, with an enterolith in the opening.   Double ligation and ex-tirpation though somewhat adherent; double suture of stump.   The more distant intestines were only much injected; no further collection

of pus found.   Cleansing of the cavity.   Tampon of iodoform gauze.
Upper part of wound sewed up to retain the bowel.   Further course
to recovery presented little interruption.   Discharged 25 days p. o.,
with a granulating wound that soon healed.   Later a diastasis of wall
beneath the cicatrix demanded a belly-band.

These two cases perhaps represent respectively Mikulicz's two
forms of peritonitis mentioned above.   One (case II) is a further evi-
dence that meteorism without free gas may obscure the liver-dullness.
The preceding symptoms of a sharp intestinal catarrh are in each case
attributable to the irritation of the developing perforation.   The first
case corroborates Reichel's recent conclusion against too much
cleansing and flushing of the abdominal cavity.   Drainage with iodo-
form gauze for a few days or longer was satisfactory.

The remainder of the article is largely devoted to the question, "Is
local peritonitis proceeding from gradual ulceration resp. perfora-
tion to be considered as a surgical disease?"   The pathology must
first be considered: The idea of a paratyphlitis is no longer con-
sidered tenable.   As perforation of the cœcum is extremely rare, it
follows that perityphlitis is practically identical with circumscribed
peritonitis starting from the vermiform.   He takes the stand that in
nearly if not quite all those cases, and certainly in all where there is
perforation, there is a collection of pus.   Hence, whether we shall
operate in the absence of sure symptoms of suppuration, especially
fluctuation, depends on the question when shall we diagnosticate peri-
typhlitis.   In this connection he gives the case of one of the assistant-
staff, operated by Krecke 17 days after onset of perityphlitic symp-
toms (ileo-cœcal pain and relative dullness, fever, etc.) Incision with
discharge of pus.   Drainage.   Complete cure.

In questionable cases even it is much safer to make an exploratory
incision than risk the danger of delay.   In hospitals, as shown by a
new case, an opening in the direction of the supposed pus may be
made and if necessary be kept open until more perfect localization or
rupture of the pus into the wound has occurred; but in private prac-
tice this is better replaced by permissible exploratory puncture.

                                        WILLIAM BROWNING.

RECENT RUSSIAN CONTRIBUTIONS TO THE SURGERY OF THE LARYNX.

1. VOSKRESENSKY: Extirpation of the Larynx for Cancer. By Dr. NIKOLAI M. VOSKRESENSKY, of St. Petersburg. St. Petersburg Inaugural Dissertation, 1890, No. 43.

2. PRAXIN: On Partial Laryngotomy. By DR. IVAN A. PRAXIN, of St. Petersburg. St. Petersburg Inaugural Dissertation, 1890, No. 76.

The first monograph, written under Professor D. I. Koshlakoff's guidance, is based on the digest of 166 cases of total or partial extirpation of the larynx, collected from international literature. The essential points of the work may be given thus:

I. Total extirpation; 130 cases, of which 17 operated upon by 7 Russian and Polish surgeons—namely by Prof. P. I. Multanovsky (4), Reiher (6) Kosinski (3), Prof. S. Bergmann (1), I. F. Sabaneeff (1), Krajewski (1), Krajewski and Wioblewski (1).

1. The patients' ages varied from 25 to 80, about 65.4% of the number referring to subjects aged from 45 to 65

2. As to the sex, in 14 cases it was not indicated; of the remaining 116, 92 referred to men, and only 24 to women.

3. Of 130 cases, 52 were epitheliomatous, while in 78 carcinoma (76 encephaloid, 2 scirrhus), was present.

4. Of 76 cases (giving details on the point), in 10 the new growth was circumscribed, in 66 diffuse. In 13 the left half of the organ was chiefly involved; in 14 the right; in 39 both of the sides were affected fairly equally; in 12 the posterior wall was diseased.

5. Of 78 (well-detailed) cases, in 27 the laryngeal cartilages were consecutively involved, in 4 of which necrosis of the structure was followed by the formation of a fistular tract opening externally on the anterior aspect of the neck.

6. In 19 cases the disease consecutively spread over the pharynx and gullet; in 19 over the trachea; in 4 to the hyoid bone; in 2 to the

base of the tongue; in 1 to the pharynx, œsophagus, tongue and hyoid bone simultaneously; in 1 to the thyroid gland.

7. In 7 cases the laryngeal disease was of a secondary origin, the new growth spreading to the organ from the pharynx and gullet (6 cases) or thyroid gland (1).

8. Of 44 cases (mentioning the detail), the cervical lymphatic glands were enlarged only in 14 (36.6%), while in the remaining 30 they were apparently normal.

9. Of 51 cases, in 11 the duration of the disease before the operation was under a year; in 16, from 1 to 2 years; in 17, from 2 to 3; and in 7 over 3 years.

10. Of 39 patients only 1 was well-nourished; in 27 the general state was bad, in 11 of a "middling" 'sort.

11. Of 64 cases, in 5 no preliminary tracheotomy was performed; in 11 it was made immediately before the extirpation, in 5 a few days previously; in the remaining the interval oscillating between 1 week and 1 year or (1 case) more.

12. In 33 cases the extirpation was performed after Billroth's method; in 15 after Langenbeck's; in 5 after Maas-Bruns-Pean's; in 7 after Kahn's; and in 3 after Bottini's.

13. In 20 cases there were removed, beside the larynx, portions of the pharynx and gullet as well; in 12, the whole or a fragment of the hyoid bone; in 3, a portion of the base of the tongue; in 14, cervical lymphatic glands; in 4, the thyroid gland; in 14, one or several upper tracheal cartilages; in 14, the epiglottis.

14. Of complications of the operation there were noticed profuse bleeding (5), wounding large-sized cervical veins (1), passing of blood down into the trachea (6), descensus of the trachea into the thoracic cavity (4), shock (3).

15. The operation lasted from 25 minutes (Gardner's cases) to $1^3/_4$ hour.

16. Of 44 cases, in 23 the after-course was entirely apyretic, while in 21 there was observed a short-lasting fever (up to 39°C).

17. Of 43 cases, in 10 the wound healed "quickly;" in 10, in from 3 to 4 weeks; in 25, in from 4 to 8; in 2, in more than 2 months.

18. Of complications of the after-course there were observed secondary hæmorrhage (6 cases), blood-spitting (2) and erysipelas (1).

19. As regards the issue, in 3 cases it remained unknown; in 24 (18 5%) recovery ensued; 38 (74.%) died; in 5 (3 8%) recidive occurred (ten patients being alive at the time of respective conmmunications).

20. Of the 24 cases of recovery, 13 (10%) remained still healthy when seen from 3 to 12 months after the operation, while 11 (8.5%) were known to have survived without any signs of recurrence of the disease for from 16 months to 5 years. Of those 11 cases of a seemingly complete and permanent cure, 2 referred to women and 9 to men, æt. from 40 to 50 (4), from 50 to 55 (6) and 62 (1). The duration of the disease (6 cases of epithelioma and 5 of carcinoma) before the operation varied from 1 to $2\frac{1}{2}$ years.

21. Of lethal cases, in 32 death was caused by pneumonia, 1 by purulent bronchitis, 2 pulmonary œdema, 1 pulmonary embolism, 2 pleuropericarditis, 3 consecutive hæmorrhage, 2 septicæmia, 6 collapse, 25 recidives, 6 exhaustion, 2 croupous pneumonia, 4 asphyxia; one patient committed suicide (about 9 months after the operation); in 11 the cause of death remained unknown. In a more or less direct connection with the operation, death occurred in 49 (48%) cases, of which, as was just mentioned, about $^2/_3$ died from pneumonia (and that mostly—27 out of 32—in the course of the first two weeks after the operation). Recidives occurred in the second month after the extirpation (3 cases), the third (3), fourth (7), sixth (1), seventh (2), from the eighth to twenty-first (5).

II. Partial extirpation; 36 cases, including 4 Russian, operated upon by Prof. Sklifosovsky (1), Reiher (2), and Prof. Simanovsky and Multanovsky.

1. Age varied from 25 to 80 years, 26 patients being æt. from 40 to 70.

2. Sex: 29 were men, only 8 female (in 4 cases unknown).

3. The duration of the disease before the operation oscillated from 7 months to $1\frac{1}{2}$ years.

4. Cervical lymphatic glands were said to be enlarged only in 7 cases.

5. Of 36 cases, in 24 carcinoma was present, in 12 epithelioma.

6. In 11 cases the left half of the larynx was affected; in 10 the right; in 1 the posterior wall; in 1 the cricoid and upper tracheal cartilages. In 12 a diffuse new growth existed; in 3 a circumscribed one; in 6 an "ulcerated." In 5 the disease involved pharynx, gullet, tongue, hyoid bone and trachea.

7. Of 16 cases, in 3 no preliminary tracheotomy was performed; in 5 it was made just before the extirpation; in 3 a fortnight previously; in the remaining the interval oscillating between 3 weeks and a year.

8. The wound healed in from 2 to 8 weeks. The swallowing became free mostly on a 2d or 3d week, sometimes as early as a 3d or 4th day, and never later than 1 month.

9. Of 36 cases, 12 recovered, 17 died, in 6 the disease recurred.

10. Of 13 cases of recovery, 9 were known to have survived from 1 to 14 months after the operation; 1, 1½ year; 1, 3 years; 1, 5; 1, 8 years.

11. Of unfavorable sequels of the operation, laryngostenosis was observed (in 2 cases).

12. Of 17 lethal cases, 9 (52%) died (8 in the course of the first week, 1 in the 5th) from causes connected with the operation (3 from pneumonia, 3 collapse, 1 septicæmia, 1 consecutive hæmorrhage, 1 mediastinitis); 7 (44%) from the primary cause (cancer); 1 committed suicide.

13. Recidives occurred in a 2d month (4) or in from 3 to 18 (5).

III. General conclusions. 1, extirpation of the larynx for cancer must be regarded as a fully justified surgical procedure, since it undoubtedly affords the possibility of a radical cure.

2. Be the selection practicable, a partial extirpation should be preferred to a total one, since the former is less dangerous and more advantageous in functional regards.

3. The operation is absolutely contra-indicated only in the presence of an extreme exhaustion, and in subjects older than 70 years. Neither enlargement of cervical glands, nor the spread of the disease over the structures adjacent to the larynx can be regarded as absolute contraindications.

4. To secure most satisfactory results, the operation must include such steps as *a*, a preliminary tracheotomy; *b*, insertion of Kahn's or Michael's tracheal cannule; and, *c*, a preliminary laryngofissure.

5. As far as possible, the operation should be followed by the insertion of this or that artificial vocal apparatus. Bruns' artificial larynx should be preferred to Gussenbauer's.

6. All accessible recidives occurring after the extirpation should be similarly subjected to a surgical treatment.

7. The strikingly more successful results obtained from the extirpation during the last 8 years (in comparison with the preceding 8 years) must be attributed to a better (aseptic) management of the wound and to the use of more perfect tracheal tubes.

II. This valuable contribution by Praxin is based upon *a*, extensive experiments and anatomic researches on dead bodies; *b*, 17 clinical cases from this author's practice; and *c*, an analytical review of 194 cases from international literature, of which 120 were derived from German sources, 41 French, 19 British, 11 American (U. S.), and the remaining from Russian (Prof.N.P. Simonovsky's 2 cases,and S. Massuriantz' case), Italian and Danish. [The review is, of course, very far from being exhaustive. Thus, it does not include Kopmann's 21 cases, Prof. E. Ericson's, etc., etc.—*Reporter*]. The author's own cases refer to 9 male patients, æt. from 2 to 52, and 8 female, æt. from 5 to 53, who were suffering from laryngeal cancer (4), syphilitic laryngitis (3), laryngeal perichondritis (2), croupous or diptheritic laryngitis (2), tubercular (1), hyperplastic (2), submucous (1), laryngitis, laryngeal abscess (1), and lympho sarcoma colli (1). In rough outlines, his method (as practiced by him since May, 1886) a "rapid laryngotomy"—consists of the following operative steps: 1. With 2 or 3 sweeps of the knife he makes a vertical incision, from $1\frac{1}{2}$ to $2\frac{1}{4}$ inches long (according to individual peculiarities of the case), into the freely movable integuments (including the subcutaneous fatty layer. 2. Having thus reached the third fascia, *i. e.*, the superficial sheet of the cervical fascia, covering the immobile musculo-aponeurotic stratum—he divides the latter along the median line through its whole thickness

down to the visceral fascia. 3. Then he introduces his forefinger into the wound and, having found the cricoid cartilage, fixes the larynx (under the lower edge of the thyroid cartilage) by means of Bromfield's sharp hook, after which, 4, he plunges a narrow-bladed and sharp pointed knife into the crico thyroid space, penetrating directly through the crico-thyroid membrane into the larynx. 5. Then he inserts into the (vertical) laryngeal wound a Trousseau's dilator, opens it and introduces a suitable cannula (usually Luer's No. 3 in adults, and No. o in children). 6. The patient is now rapidly made to assume a sitting posture (in order to prevent the blood flowing into the larynx), and the operator proceeds to tie any bleeding vessels, finishing by inserting some sutures into the wound of the soft tissues.

As a rule (in 11 out of 17 cases), the operation proves to be fairly easy, taking from 1 to 5 minutes' time. The crico thyroid wound commonly embraces the cannula sufficiently tight to prevent any penetration of blood into the trachea, notwithstanding a rather profuse venous hæmorrhage. The main propositions, laid down by Dr. Praxin, may be briefly summarized as follows: 1. Speaking generally, laryngotomy can be performed by far more rapidly comparatively with tracheotomy.— 2. It should be undoubtedly preferred to the latter in the presence of the following conditions: *a*, hypertrophy of the thyroid gland, or a greatly developed isthmus—provided the asphyxiative symptoms, necessitating the operation, are dependent upon other causes than pressure by the hypertrophied organ; *b*, tumor of the cervical glands (lymphosarcoma, etc.), covering the trachea or displacing it laterally; *c*, inflammatory or phlegmonous swelling of the neck; *d*, an abnormally short distance between the cricoid cartilage and manubrium sterni (in very short-necked persons); *e*. high-graded asphyxia or profuse hæmorrhage in thick-necked subjects.—3 Laryngotomy may be successfully resorted to (instead of tracheotomy) in all possible stenoses above the conoid ligament (be they dependent upon simple œdema of the larynx or phlegmonous laryngitis, laryngeal perichondritis or cancer, etc.)— 4. It is, however, absolutely contra-indicated in cases of tracheal intrinsic strictures, as well as in those of stenoses (hyperplasy, scars, abscesses), situated in the lower division

of the larynx or at the level of the cricoid cartilage —5. Tracheal stenoses, caused by outside pressure (by hypertrophied thyroid gland, aortic aneurism, large abscesses), constitute a but relative contra-indication, according to individual peculiarities of the case —6. Contrary to the views of French surgeons, laryngotomy is by no means contra-indicated in children.—7. A prolonged wearing of the cannula after laryngotomy is apt to be followed by wasting of the cricothyroid muscle with consecutive corresponding functional disturbances (loss of high tones on vocalisation, etc.). The sequel is especially liable to occur in subjects with a narrow crico-thyroid space, and, after wearing a large-sized cannula. It may be prevented—at least, to a certain extent – by dividing the cricoid cartilage (simultaneously with the crico-thyroid membrane) and inserting a middle-sized cannula. Still, in view of the risk, laryngotomy should be avoided "in all such cases (especially in singers) where the patient's vocal apparatus is affected by the morbid process only to a slight degree, and where a complete restoration of the vocal functions can be reasonably expected."—8. Laryngotomy—or rather wearing a laryngeal cannula—never gives rise to laryngeal perichondritis or ulceration of the laryngeal mucous membrane. An unduly bulky cannula, however, can sometimes (3 cases out of 211) cause hyperplasia of the membrane. The only peculiar complication of laryngotomy is constituted by fracture of a degenerated cricoid cartilage, which, however, occurs but very rarely (4 cases out of 211, ending lethally from other causes than the complication, which was detected only on the necropsy).

VALERIUS IDLESON.

INDEX OF SURGICAL PROGRESS.

CHEST AND ABDOMEN.

I. Statistical Investigations on the Etiology of Mammary Cancer. By Dr. H. Schulthess. The mortality from this disease in the Canton of Zurich, 53 specially observed cases, and a comparison from the general literature of the subject, are made the basis for exhaustive study. His conclusions are:

Frequency.—Of 1,000 persons, 23 die from cancer of the breast. Of 100 females over 40 years of age, 1 dies from this cause.

Sex.—This has the most important influence, as 98% of all patients are females, while 1.39% are males.

Age.—In women the disposition hereto increases from the development of the sexual organs—before which it is nil—with the age, a special frequency being noticeable about the time of the menopause. In males the material at hand is too small to warrant any statement.

Influence of Sexual Activity in the Women.—(*a*) Menstruation—No influence can be shown, for want of comparative material.

(*b*) Sexual intercourse.—Its frequency is without significance.

(*c*) Gravidity.—Neither this of itself nor its frequency is in general of any importance, though there are rare cases in which it certainly represents an etiological factor.

(*d*) Lactation.—Of itself this is indifferent as regards the later development of malignant neoplasms.

Former Diseases of the Mamma as Etiological Factors.—(*a*) Mastitis.—If any factor can certainly be made responsible, it is puerperal mastitis; this plays a part in 14% of all patients, or in 28% of those who have borne children. In the cases where cancer attacked the gland that had escaped inflammation, or only one mamma where both had had mastitis, we must assume an unknown factor of greater

importance than belongs to the mastitis. Perhaps in these cases we may fall back on congenital tumor rudiments in Cohnheim's sense.

(*b*) Eczema appears, according to English authors, to stand in direct connection with cancer of the mamma. Our cases suggest at the most a *locus minoris resistentiæ*

TRAUMATIC EFFECTS.—(*a*) A single intense trauma was found to be an etiological factor in $12\frac{1}{2}\%$. This was specially evident in men.

(*b*) Repeated injuries, each slight in itself, such as happen in house and farm work, and in many callings, now and then, perhaps, from poorly fitting garments, probably have an influence in disposed persons, and under certain conditions that we do not further understand. At any rate we are not justified in attributing cases, where no other etiological factor is present, simply to small mechanical insults as an independent factor.

SIDE OF THE BODY.—This has absolutely no importance. Males as well as females show an equal frequency on the two sides.

LOCALIZATION IN THE MAMMA.—The point of predilection for the beginning cancer is the upper outer quadrant; the region of the nipple and the areola appears to be a favorite seat of the same.

HEREDITY—Ten per cent of the cases are said to be hereditarily handicapped. Still, on comparing herewith the mortality statistics of cancer, this can only be allowed in cases of repeated cancer in the family, while in other cases it is at least doubtful.

The individual disposition to disease and the general condition of the patient can not be estimated statistically. It appears that there is no uniform etiology for mammary cancer For a large number, the majority, of patients we do not know whence the neoplasm comes.— *Bruns' Beitrage z. klin. Chirg.*, 1889, Bd. iv, heft 3.

II. By What Means Can the Occurrence of Pseudo-Membranous Adhesions From Intra-Peritoneal Wounds Be Prevented? By DR. R. STERN (Heidelberg). Although septic peritonitis is the most frequent cause of death after laparotomy, other unfavorable results occur to all operators, quite independent of any infection. Amongst these latter occurrences intestinal occlusion plays

an important role.   Statistics from various operators show   that this happens in about 1 % of all cases ($^1/_3$ to $1^1/_2$ %.)   This may be from:

1. Incarceration of intestine between the pedicle where sutured to the abdominal wall and some other viscus.

2. Inflection of intestine by an adhesion attached to it.

3. Twisting on its axis.   He finds with Olshausen the second form the most common, since two-thirds of the 25 cases that he has collected (and tabulated) were due to adhesions.   In 7 this was between pedicle and gut, in 3 between omentum and gut, and in 7 between abdominal wound and gut.   The treat..1ent of the pedic'e was intraperitoneal in 16 of these 17 cases, and in 4 of the remaining 8.

The various suggestions and attempts that have been made with a view to the prevention of these adhesions are next discussed.   He then describes 29 experiments on rabbits, in which various agents were used to coat over the stump and thus prevent attachments of the stump, at least, to other parts.   His conclusions are:

1. Intraperitoneal wound-surfaces generally become attached to their surroundings.

2. Infusion of large quantities of sterilized normal salt solution does not prevent this.

3. Covering the stump with vaseline is likewise ineffective, because it does not adhere sufficiently.

4. Covering the stump with a mantle of tallow (firm at the body-temperature) prevents adhesions, but is technically difficult, can scarcely be split in desired thinness, and is questionable from its necessarily higher temperature.

5. Brushing the stump with collodion, sufficient to form a thin, smooth membrane, regularly prevents adhesions and shows no injurious side effects.

We of course recognizes the difficulties that most frequently interfere with the practical application of this principle, and also that adhesions between the abdominal wound, excoriated peritoneum and adjacent parts must be prevented in other ways.

Dembrowski's experiments, showing freedom from adhesions where various substances had been injected into the peritoneal cavity of dogs,

and in other ways at variance with Stern's experience, are considered in an appended note.—*Bruns' Beitrage f. klin. Chirg.*, 1889, Bd. iv, heft iii.

<div align="right">Wm. Browning (Brooklyn).</div>

ORTHOPÆDIC.

I. Upon Painful Flat-Foot. By Dr. E. Kirmisson. Various theories regarding the pathogenesis of flat-foot are discussed, and the conclusion arrived at that without doubt alteration of the bony structures occurs as the final result of the primary conditions, whether these latter are due, according to Duchenne, to insufficiency of the peroneus longus muscle, lesions of the cartilages (Gosselin), or weak-ness of the ligamentous apparatus (Lefort, Tillaux). It is the position of valgus which gives rise to the interference with locomotion in these cases, and not the flat foot. The different methods of correction by means of osteotomy are justified by the existence of the bony affec-tion. Two cases are reported, the one being extirpation of the os navicularis, with a good functional result, and the other a cuneiform re-section of a portion of the medio-tarsal joint, after the method of Ogston.

(The latest method of correcting the condition under discussion, and that which promises to supersede all others, that of Trendelenburg, either has not as yet come under the notice of the author, or its ad-vantages have not been fully appreciated.)—*Rev. d' Orthop.*, 1890, No. 1.

<div align="right">Geo. R. Fowler (Brooklyn).</div>

REVIEWS OF BOOKS

A MANUAL OF MODERN SURGERY for the Use of Students and Practitioners. By JOHN B. ROBERTS, A.M., M D., Professor of Surgery in the Woman's Medical College of Pennsylvania; Professor of Anatomy and Surgery in the Philadelphia Polyclinic; Lecturer in Anatomy in the University of Pennsylvania. With Five Hundred and One Illustrations. Philadelphia, Lea Brothers and Co. J. H. Chambers and Co., 914 Locust Street, St. Louis. Mo.

In this work of eight hundred pages, the author has endeavored to give to the profession, in a condensed form, the doctrines and procedures of Modern Surgery. He has made it a work devoted more especially to the practice than to the theory of surgery. The consideration of untried innovations, expedients of doubtful value, traditional and historic questions, has been given no place. The operative procedures recommended are those which have been adopted by the largest number of practical surgeons. Aside from the written surgery of which the author has availed himself, his own large experience has added many valuable features to the work. It contains many practical points in diagnosis, which renders it the more valuable to the practitioner; and the systemization which pervades the whole work, together with its perspicuity, enhances its value as a student's manual. There are not described a number of theories and expedients of variable value, from which the reader may choose; the scope of the work being limited, those are given which seem to the author best; the others are merely mentioned or briefly outlined. He has chosen for the reader, and in these selections has exercised general good judgment.

The style is pleasing. There is a tendency to eliminate objectionable terms, and to Anglicize the foreign words used in surgery. English endings, are attached to the plural of Latin nouns, resulting in such

hybrids as "fibromas" and "coccuses."   The terms "contre coup," "en bissac" "en masse" and the like, savoring of pedantry and affectation, are given their English translations.   Proper name nomenclature is opposed, and the names "Colles' fracture" and "Pott's fracture" are discarded as useless and confusing.

The whole work is divided into two parts, which are subdivided into twenty-seven chapters.   Part 1. is devoted to "General Surgical Pathology, or Principles of Surgery."   In this the demonstrated and accepted theory of the relation of microorganisms to disease is clearly set forth.   The subject of ulcers is briefly treated.   No classification is given, excepting the division into "healthy" and "unhealthy"   The author does not think it necessary to give a distinctive name to each; and the treatment is rather general.   The term sapræmia is used to signify ptomaine poisoning; septicæmia is defined as infection by putre- factive organisms; and the symptoms of septicæmia and pyæmia are grouped together.   The author acknowledges a discrepancy of opin- ions on these subjects.   Green's classification of tumors is adopted.   The subject is well treated, and with abundant illustrations.   The word "cancer" is used but once, and then only to say that the term should not be retained in surgical literature.

In speaking of wounds the author states his belief that delayed shock is an impossibility, and that cases so named are instances of septicæmia, fat embolism, or some imperfectly understood condition. In the treatment of wounds he insists upon free drainage, and the most rigid antisepsis   The straight bayonet needle is nearly always preferrd to the curved variety, and no allusion is made to the Hagedorn. As might be expected, the aseptic metallic handle figures prominently among the knives and other instruments.   Little copper, boxes, in which the instruments can be stored for transportation, are commended. These with the instruments can be conveniently heated just before an operation.

The treatment of the subject of anæsthesia shows that the data have been obtained from clinical observation.   It is assumed from the be- ginning that ether is far preferable to chloroform, and the relative merits of the two are not discussed.   The advantages claimed for

chloroform over ether, says the author, are much overrated because of
the frequent improper administration of the latter. Chloroform is
quite ignored, and no indications for its use are given. The author
believes in the hypodermatic injection of morphine with atropine about
fifteen minutes before the anæsthesia is begun. He is also in accord
with the recent teaching, that untoward heart symptoms occurring dur-
ing ether anæsthetization should not be met with alcohol; nor does he
believe that alcohol should be administered before etherization for the
purpose of averting shock. There is food for thought in the sugges-
tion that some of the deaths attributed to anæsthetics may be due
to the entrance of air into the veins during the course of operation.

The principles or fundamental laws of operative surgery are given
in nine terse sentences, which surgeons may observe with profit. In
the last of these is the warning that suppuration in an operation
wound, in tissues in which originally there was no suppuration, is us-
ually due to improper precautions on the part of the surgeon or his
assistants.

The last chapter of the first section is devoted to plastic surgery,
in which the principles of that reparative art are well set forth.

Part II, which comprises more than three fourths of the whole work,
is devoted to "Special Surgical Pathology, or Practice of Surgery."
Each of the fifteen chapters in this section is worthy of comment, but
space will only permit allusion to a few salient features, the points
which impress the reviewer as especially worthy of note. The author
seems always to have in mind possible specific cause of obscure dis-
eases. Such expressions as the following are often met. In speaking
of encephalitis, he says: "All chronic cases should be subjected to
antisyphilitic treatment, as should all cases of supposed brain tumor."
The term concussion of the brain is rejected, and in its stead contusion
or laceration is used. Inasmuch as functional disturbances are due to
organic changes, concussion, which is a vibration and not a condition
of disease, gives rise to symptoms as a cause of contusion or laceration.
Among the causes of cerebral compression, tumors, for some reason,
are not enumerated. The author does not believe that the general
surgeon is possessed of all the available knowledge pertaining to sur-

gery, and occasionally suggests that this or that be left to the specialist in the particular branch. In the description of operative procedures, the surgeon is told not only what to expect in the natural course of things, but he is also frequently warned as to what possibilities of the case he should have in mind before undertaking the operation, and what conditions he should be prepared to encounter.

In the treatment of acute anæmia precedence is given to direct transfusion toward the heart over the more satisfactory and simple method of saline infusion. The former is described and illustrated, whereas the latter is barely mentioned. Whatever may be the author's reason for giving this preference, the prevalent surgical practice, at least in this country, shows the greatest favor for the infusion of saline solution. There is an especially practical chapter devoted to the controll of hæmorrhage. A number of rules are laid down to guide the surgeon in the arrest of arterial hæmorrhage by the use of the ligature. Under each rule are the reasons for its use. and a number of exceptions. In this condensed form are given principles which, less concisely expressed, would occupy many pages. Styptics are regarded as useless agents for controlling such bleeding as is met in general surgery; pressure and ligation are considered the only necessary hæmostatics.

No section of the work is more worthy of note than that on aneurism. In this chapter the author not only shows a thorough appreciation of the subject, but also an ability to impart his knowledge in a most available form. As in other chapters he endeavors to eliminate misused expressions, so in this does he refuse to recognize "dissecting aneurism."

The terms simple and compound fracture are rejected as misleading and not self explanatory, and in their places the words "closed fracture" and "open fracture" are used; which on the whole seems a change worthy of general adoption. In this abundantly illustrated chapter are frequent allusions to Stimson's work, from which a number of cuts are borrowed. The author believes that free drainage is an essential factor in the treatment of open fractures, though in these days we see many put up snugly in plaster, and left for weeks in their original dressings.

He trephines in cranial fractures more heroically then is generally taught, as is indicated in his syllabus of treatment of such injuries. We are bound, however, to respect the dictum of Dr. Roberts on this subject.   He holds that trephining properly performed is in itself so free from danger that in cases of doubt it had better be resorted to rather than allow the patient to run the risk of subsequent untoward complications.   The surgeon is exhorted to become a neurologist to the degree of familiarizing himself with cerebral localization.   Fracture of the clavicle he treats by dorsal recumbency for ten days, and then ordinary immobilization bandage.   This seems a happy modification of two methods.   Few patients will submit to the irksome position of recumbency during the whole period of healing only with the hope of getting a better cosmetic effect.   It is recommended that fractures of the lower extremity of the humerus be generally treated in the extended position, special attention being called to the normal angle of abduction in the forearm.   Treatment of fracture of the patella by wiring is briefly dismissed as unjustifiable.   Nor is secondary wiring after refracture or rupture of the fibrous union recommended.   Suffice it to say that the objection to this procedure has arisen from imperfect antisepsis, and that the surgeon who refrains from wiring the patella acknowledges his inability to perform an aseptic operation.   Surely, there is such a thing as asepsis; asepsis is within the range of surgical possibilities.

The chapters on diseases and injuries to the joints, which include dislocations and excisions, written by Dr. Morton, maintain the general high standard of the work.   The essence of the subject of hip-joint disease is found in the article on that subject.   In the treatment of downward dislocations of the head of the humerus the method of Kocher is wanting.   Had this method been given so much space might not have been devoted to traction and anæsthesia.

The chapter on pelvic and abdominal surgery contains much sound doctrine.   Holding, as he does, asepsis in supreme regard, Dr. Roberts unhesitatingly opens the peritoneal cavity.   "If doubt exists as to the propriety of opening the abdomen for purposes of discovering and repairing visceral damage, it is usually wise to give the patient the

benefit of the doubt and operate." For closing the abdominal wound the use of interrupted sutures, passing through the whole thickness of the abdominal wall and including the peritoneum, is considered the best plan. In the after-treatment opium is withheld as much as possible, and incipient peritonitis is considered an indication for the administration of salts. He believes that active peritoneal inflammation will not often occur if when the first symptoms appear abstinence from opium is enforced, and saline purgatives are administered. Several illustrations in this chapter are borrowed from the work of Greig Smith, from which the author occasionally quotes.

The subject of hernia is well dealt with. The author is in sympathy with the growing belief that radical operations for the cure of hernia do not, as a rule, effect a radical cure.

With reference to a mooted question he says, "of all the operations proposed for the radical cure of the more severe cases of hæmorrhoidal disease, the best probably is excision and cauterization "

For the treatment of prolapse of the rectum he gives his own method.

The chapter on amputations, for which the author in his preface states he is indebted to Dr. Morton, is sound and concise.

The fact that this work is eminently practical can not be too strongly emphasized. It is modern; and as its teaching is that generally ac cepted and such that affords little opportunity for discussion, it will be lasting. It is clear and concise, yet full. The book is entitled to a place in modern surgical literature. JAMES P. WARBASSE.

A RESTROSPECT OF SURGERY, January, 1886–January, 1890. Prepared by FRANCIS J. SHEPHERD, M.D., C.M., Surgeon to the Montreal General Hospital, etc. Montreal Gazette Printing Company, 1890, 8vo. p. 261. J. H. Chambers & Co., 914 Locust Street, St. Louis, Mo.

This work is a reprint of the valuable reports on current surgical literature made during the last four years by Professor Shepherd in the *Montreal Medical and Surgical Journal.* The abstracts are succinct

and comprehensivo and present an excellent *précis* of the surgical work
of the period.   JAMES E. PILCHER.

MEDICAL DIAGNOSIS, WITH SPECIAL REFERENCE TO PRACTICAL MED
   ICINE. A guide to the knowledge and discrimination of diseases. By
   J. M. DaCOSTA, M. D. Professor of Practice of Medicine at the Jeffer-
   son Medical College, Philadelphia, etc.   Seventh Edition, Revised.
   Philadelphia, J. B. Lippencott & Co., 1890. 8vo., p. 995. J. H.
   Chambers & Co., 914 Locust Street, St. Louis, Mo.

The students and practitioners of medicine, who, during the past score
of years, have exhausted six editions of DaCosta's work, form a jury
most worthy of pronouncing upon its merits, and their verdict is favor-
able.   In the present edition, the author has given the subject matter
a complete revision, bringing it as fully as practicable up to date.
                                                      JAMES E. PILCHER.

CIRCULAR ENTERORRHAPHY BY A NEW METHOD.

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INTESTINAL operations until recently were recognized as quite fatal and the ultimate results of such surgical procedures as rather unsatisfactory. But it must not be concluded that the bowel operation of the present day is totally relieved of all its fatality, and its unsatisfactory results. Yet we can say that the strife of surgeons and the competition of experimenters have resulted in hitherto unknown progress in the field of intestinal repair. The results of operations on the alimentary canal depend, probably, more on the individual skill of the surgeon and the condition of the parts than do those in any other field of surgical work.

Hence arise such varying reports and such elastic remarks in this department of surgery. The relative newness of the work, the difficulty in forming an accurate diagnosis and the impossibility of applying distinctly formulated rules to concrete cases lend additional confusion. To this may be added the fact that but relatively few trained surgeons are doing much work in the matter and hence real practical knowledge in diagnosis and technique is not very generally distributed. From such views it is easy to conclude that individual skill and dexterity in operations on the bowels must be acquired by other means than books and occasional cases seen in practice. Under ordinary circumstances then there is but one way to acquire personal, dextrous skill in operations and personal power in diagnosis of intestinal diseases and that is by experimentation on animals and the human cadaver. Even

watching the skilled hands of the masters will not alone
suffice.   Personal practice and responsibility are the elements
that develop the intestinal surgeon.   In this article we will
speak of one of the operations on the bowel which largely en-
grossed the attention of all past surgeons who devoted any
thought to the subject.   It is known as *Circular Enterorrhaphy*,
which suggests the reunion of the circumference of a divided
intestine.   For thousands of years men have been attempting
to use what is termed a technique or method to restore the
alimentary canal and fæcal circulation to a normal condition.
Amusing and queer things were done in days gone by in order
to accomplish the feat of reuniting an intestine.   The 12th
century sees the London surgeons and the Paris masters in-
troducing "elder pypes in the guttes under the seme, that
the seme rotte not."   History records the use of cylinders of
dried intestine, bone, wax and tallow to aid in uniting the
bowel.   Ferrules of metal and the dried tracheas of animals
were also employed.   All these objects were expected to be
absorbed or passed by stool after the gut wound was healed.
Now, we practiced circular enterorrhaphy in all the forms
known to the books, our experimental operation on dogs
and cadavers cover three years and over 200 operations.   The
time, the number of experiments and particularly the
autopsies which we performed ourselves gave us many oppor-
tunities to see defects and to study for improvements.   The
faults, defects and imperfections were what first arose in cir-
cular enterorrhaphy. A great many trials were made in various
ways to observe the final effects of circular reunion of the
divided bowel ends in dogs.   After the trials are all over I am
more than ever convinced that an innate sense of justice and
proper respect for our fellow man should prohibit any surgeon
from attempting to do the operation for the first time on a
human being.   The sources of danger in circular enterorrhaphy
are still real and formidable and are at present being met by
substituting the rising operation of intestinal anastomosis for
it.   A statement of some of the dangers which arose in our
work may be of interest to the surgeons of this field.

a. Circular enterorrhaphy paralyzes totally or partially, for a
variable time, the segment of the operated bowel.   The paraly-

sis thus checks peristalsis and the immediate object of the operation, which is to overcome obstruction, is lost. The fæcal circulation may not be aided and relief is delayed. While relief is being delayed, fæces, fluids and gas are accumulating above the point of occlusion, and also increasing peristaltic violence above the obstruction may endanger the rupture of the newly made stitches by persistent pressure at the seat of operation.

b. The lumen of each gut may be of different size and hence difficult to safely unite. The lumen of the large gut could be narrowed by puckering or a V-shaped excision, but every pucker and wound adds danger to the procedure.

c. It may be followed by stricture. As a matter of fact it was many times followed by stricture, which narrowed the gut lumen one-fifth to one-third or one-half of its original size. In some cases I found that the stricture was even obstructing the passages of gas or fluid or fæces by the gut narrowing and kinking on itself. The actual lumen of the stricture was about the size of a crow's quill. These occurred in autopsies from 1 to 3 weeks after the operation. Would the strictures progress to contraction or dilatation of their lumen?

d. Fæcal fistula is apt to occur at the seat of operation from gangrene of the gut tissue due to the pressure of numerous sutures. Fæcal fistula is one of the essential objects to overcome in any intestinal operation.

e. The gut is in a pathological condition due to injuries from violent peristalsis and obstruction. The bowel having impaired physiological functions—especially circulation and nutrition—does not readily unite. The constant pressure of gas, fluid and fæces against the wall of the bowel will stretch its tissues so that their vitality of repair is lost. The power to retract to the normal condition has ceased, because excessive and long-continued pressure has paralyzed the nerve supply.

In some dogs we found in the autopsies knuckles of fæces actually projecting through the gut wall, and these were in dogs which we had killed to obtain specimens, and which appeared fairly healthy after such operations. It would, no doubt conduce to safer recovery if a considerable piece of path-

ological bowel was entirely cut away by resection—until healthy gut was met.

f. One of the essential factors in circular enterorrhaphy is the time required to perform the operation. If one uses from 20 to 40 Czerny-Lembert sutures, it will consume at least 45 to 60 minutes. We considered in our experiments that the exposure of a dog's intestines for 45 minutes was sufficient, occasionally, to kill him. Hence, if 45 minutes' exposure was enough to shock some dogs to death, varying durations of exposure would have corresponding effect on final results. The shock in the case is due to low temperature and manipulations, *e. g.*, several times I have stopped a dog's breathing by intentionally dragging on his stomach.

g. We found that after the operation kinking of the gut frequently occurred at the seat of action, it was mainly due to the adhesions formed at the point of operation—and also that the peristaltic bowel motion was kept up on each side.

h. Another source of danger that occurred quite a number of times in the operation was the invagination of the proximal bowel into the distal bowel at the seat of operation. This invagination not only occurred but killed several dogs, so that it must be named as a real source of danger.

Some of the above reasons induced me to cultivate other methods in performing the operation. I cultivated two new methods but will only speak of one in this article. The idea in this new operation is to gain good immediate, and remote results —no stricture or tæcal fistula. I have never read or heard of the operation being done.

The old idea of old intestinal surgeons was that to secure perfect healing of bowels, serosa should be approximated against serosa. Now I found by actual experience that serosa against serosa will not always heal, and not only that, but even if serosa is applied against abraded serosa the healing is not universally perfect. The surest healing is acquired by applying abraded or scarified serosa against scarified serosa, and retaining it in a fixed position; scarified peritoneum approximated against scarified peritoneum and fixed in position so as to render physiological and mechanical rest efficient, gives the surest and most perfect healing. Now, I applied this law still

further to the fact, known through all ages, that scarified or abraded surfaces, if coapted or fixed in coaptation, will heal universally. Hence it matters not whether it be mucous membrane applied against serous membrane, or mucous membrane applied against any other membrane; so long as both membranes were well scarified, healing would result. With this law in view I began experimenting with the healing of scarified mucous membrane to scarified serous membrane. Of course it healed like the two surfaces of a cut wound. In dealing with the mucous membrane of the intestines one must not forget that he has to do with glands—a secreting surface. My first mistake was that I did not properly destroy these glands. The follicles of Lieberkuhn and the tubular glands or other secreting apparatus extended much deeper into the gut wall than I, at first, supposed, and hence I lost some dogs by not cutting the mucous membrane well away.

In this operation, like Jobert's operation, one must definitely determine the direction of the bowel, the surgeon must positively know the direction of the fæcal circulation. The standard to go by is, first and above all, the cæcum, and second, the sigmoid, and third, the duodenum. I tried Prof. Nothnagle's test which, he claims, distinctly shows by certain contractions the upward or downward direction of the gut. Prof. Nothnagle claims to have discovered, while studying the gastro-intestinal canal, that when he applied against the gut wall a potassium salt, circular constriction occurred. The circular muscular fibres on the gut wall contracted very much more in proportion than the longitudinal muscular fibres. He also claims that when the bowel wall is brought in contact with a sodium salt that ascending peristalsis took place. We carefully repeated these experiments, and the results were so unsatisfactory that we never could tell, by the test, which was up and which was down. Both sodium and potassium salts produced vigorous muscular contraction, and we were, time and time again, positively able to demonstrate vigorous and violent circular muscular contractions from both salts. But the doubtful section of the experiment arose in the part called ascending peristalsis. Prof. Senn claims that he corroborated

these tests in 15 out of 16 cases. More time and light to use the test may give different results.

However, it is an odd peculiarity that the longitudinal and circular muscular gut layers each have a particular affinity for a different salt. If the test could be applied with reliable results in concrete cases, it would be an invaluable aid in much intestinal work. In the second operation I did after Jobert's method, I made a mistake in the gut's direction, which cost the dog's life. In one of the operations on dogs while performing the operation of this article, I forgot and invaginated the bowel the wrong way, which killed the dog, so it may be observed how important it is to positively determine beyond a doubt the direction of the fæcal circulation. The following experiments, with self-explaining remarks, will make the operation and results demonstrate the utility of the procedure.

Experiment 242.—Dog, weight, 23 lbs. This was a dog on which we had performed anastomosis for intestinal wounds with the segmented rubber plate, 28 days previous. He had three bowel perforations made by a 32 calibre ball. It was also the first time we had performed the operation. The animal was chloroformed, belly shaved and loop of intestine drawn out of a three-inch median abdominal incision. The direction of the bowel was determined from the cæcum as a standard. After completely severing the bowel a rubber tube three inches long and one fourth inch in diameter was stitched into the proximal gut, and an inch of the serous surface of this gut was scarified. The mucous membrane of the distal bowel end was dissected off one-half inch with curved scissors, and then the same freshened surface was well curetted so that all the intestinal glands would be destroyed. Now, the proximal bowel end was pushed into the distal bowel lumen, as one joint of stove-pipe is pushed into another. The distal bowel was drawn over the proximal and sutured in position. A graft of omentum was carefully folded around the operated parts and fixed by sutures. The sutures which fixed the two gut walls together passed entirely through the circumferal margin of the distal bowel and also through the peritoneum and muscular layer of the wall of the proximal gut, avoiding the penetration of its mucous membrane. The dog died on the third or fourth day. The second operation revealed the existence of a chronic peritonitis—a progressive fibro-purulent peritonitis of a most typical form. Nature had made brave efforts to

encapsulate pus and infection, and no doubt would have succeeded but for the second operation, which induced general peritonitis. The circular enterorrhaphy was healing nicely. The graft had contracted firm and strong adhesions. The rubber tube kept the fæcal channel open, and also held in constant approximation the two gut walls while healing. Three points were noticed in the proximal gut at the seat of operation which showed that the needle had penetrated too deeply but were healed. As the parts of the intestines operated on were progressively healing, it may be considered that the dog's death was due to lighting up anew the peritoneal infection. Dogs do not resist infection well in second or third abdominal sections, especially when done close to one another as regards time. No doubt had this been the first section the dog would have lived. The essentials of the operation are cleanliness, the long rubber tube to keep the fæcal channel patent and the gut walls in contact, and to prevent eversion or rolling out of the gut ends. The mucous membrane must be thoroughly dissected away and a large omental graft must be well applied and sutured in position.

Experiment 243.—Dog, female, weight 75 lbs. The usual preparations were made, and out of a median abdominal incision a loop of intestine was drawn. The first thing to do in this operation after the abdomen is opened¦ is to determine the direction of the intestinal canal or the fæcal circulation. I always took the cæcum as the standard by which to decide. The sigmoid and the duodenum were often valuable, but not to be compared with the cæcum.

After the gut's direction had been determined, it was severed. The serous surface of the proximal gut end was scarified for an inch, and a rubber tube, one-half inch in diameter and four inches long, was stitched into it. The mucous membrane of the end of the distal bowel was dissected off with curved scissors for three-fourths of an inch. The proximal bowel was then inserted into the distal gut lumen in the same manner as one joint of stove-pipe is joined to another. The circumference of the distal bowel wall was sutured to the serous or peritoneal surface of the proximal gut by an interrupted suture. An omental graft was snugly wrapped around the operated parts and sutured in position. The abdomen was closed by four stitches to inch, linen, including the skin fascia, conjoined tendon of the abdominal oblique muscles (the three), and peritoneum. The dog made an uninterrupted recovery, and twenty-four hours after the operation ate and drank. She began to play after three days.

Twenty-three days after I sacrificed her for other purposes.

The autopsy was very instructive and suggestive. The abdominal organs were all healthy in color and all other ways, except an entero· lith about the size of a man's fist.   The enterolith consisted of hay, straw, and hair, which she had bit from her own body.   It was very difficult to know why it lodged just above the operated parts, as the gut was scarcely narrowed.   It was not contracted a particle more than the width of the bowel wall.   However, no doubt the newly wounded gut had not yet recovered its normal dilatability and con· tractility—elasticity.   It would also be hindered in its movements by the graft which had formed firm and strong adhesions on the entire cir- cumference of the gut wall.   The adhesions were of the nature indi- cating the formation of new tissue from cell proliferation—new con- nective tissue and blood vessels with, no doubt, nerves and lymphatics. I think the enterolith would have dissolved away as the fluids trickled through it.   A peculiarity in the case is that the dog showed no signs of being encumbered with an enterolith or any obstruction.   In fact, she played, ate and drank until the end.   In testing the capacity of the normal gut and the part operated on scarcely any difference could be detected in size, hence the cause of the enterolith was no doubt due to the difference in the function of the operated and non·operated parts.   The anatomical difference was insufficient to account for it. It appeared to me as a suggestive sample of Littre's hernia or the par· tial paralysis of any gut after circular enterorrhaphy.   Its peristalsis was partially destroyed, and hence was a menacing point in the fæcal circulation endangering intestinal obstruction at any moment from sheer mechanical accidents, due more to physiological defects than in sufficiency of anatomical structure.

Experiment 250.—Dog, female, weight, 8 lbs.   Animal chloro- formed, belly shaved, and a three·inch median incision made.   A loop of ileum was drawn out and divided.   A one-fourth inch rubber tube, three and one-half inches long, was stitched into the proximal end of the gut by a single stitch of linen thread.   The longer part of the tube projected above the divided gut end.   The distal bowel end was then seized and the mucous membrane was clipped off for one-half to three- fourths of an inch by means of a curved scissors.   To be sure the mu- cous membrane was destroyed it was well raked over with a fine- toothed forceps.   The proximal gut was then seized and the serous membrane on its end for about an inch was well scarified.   Now the proximal end, containing the rubber tube, was inserted into the distal end, and the edge of the circumference of the distal gut was sutured against the serous membrane of the proximal gut by a partly continu-

ous and partly interrupted suture. A graft was well wrapped around the operated parts, and sutured in position. Abdomen closed by sutures, linen, four to inch, passing through skin, fascia, theca or abdominal tendon formed by the blending of the oblique muscles. The dog recovered quite well, was moderately sick for two days, and then ate and drank continuously, and even played.

I shot the dog thirteen days after. The autopsy revealed perfect healing, few adhesions and a firm and solid graft which hermetically sealed the operated parts. By a careful observation the gut lumen appeared to be narrowed about one-seventh of its original. This would never have disturbed the future economy of the dog under natural or ordinary circumstances. The result of this circular enterorrhaphy was about as perfect as I had ever seen among a large number.

Experiment 251.—Dog, male, weight, 15 lbs. Animal chloroformed, belly shaved, and a four inch median incision made. A loop of small intestine was pulled out and severed. A rubber tube, three-eighths of an inch in diameter and three inches long, was sutured in the proximal end of the bowel by passing a suture through the gut at its incised margin and through the rubber tube wall. The distal gut end was secured, and the mucous membrane was well clipped away with curved shears for about one-half inch. The proximal gut was well scarified on its mucous surface for an inch from its cut end by a needle point. The proximal bowel with its tube (rubber) was then inserted or invaginated into the end of the distal bowel. The distal bowel circumference was then sutured to the serous surface by a continuous suture, four to the inch. An unsevered graft from the side of the great omentum was wrapped around the operated parts and sutured in position. Occasionally the serous surface over the operated parts was scarified, as well as the applied surface of the omental graft. The dog was sacrificed ten days after for the purpose of securing the specimen. The graft had formed firm and thick adhesions, completely sealing up the operation. The gut had well healed. The sutures had not yet dropped into the gut lumen. This taught me that interrupted sutures are safer than continuous. The general adhesions of this operation were mainly few in number. The tube was gone, and it generally disappeared between the second and fifth day. One of the essentials to success in circular enterorrhaphy is the use of this tube, which I learned to use from experimentation. It keeps the bowel lumen patent and aids in preventing invagination, which often follows the operation. The dog made a prompt recovery. He drank, ate and played from the third day after the operation.

Experiment 254 —Dog, female, weight, 11 lbs. The usual prepara-
tions being made, a loop of intestine was drawn out of a median inci-
sion and divided. This dog was sick at the time of operation. His
intestine was so œdematous as to be between two and three times its
normal thickness. It was succulent, swollen and infiltrated. The
proximal gut was scarified on its serous surface, and a three-inch long
rubber tube sutured into it. The mucous membrane was clipped off
from the distal gut for one half to three fourths inch. In clipping the
mucous membrane away from the distal gut I accidentally cut a hole
in the wall of the bowel at the point of denuding the mucous membrane.
I thought it would be all right if I sutured this little hole, which was
done. The proximal gut, containing the tube or rubber, was invagin
ated into the distal bowel, and the circumference of the distal bowel
was sutured to the serous membrane of the proximal bowel by a partly
continuous suture and partly interrupted one. The parts were scari-
fied and an unsevered omental graft applied over the whole, and held
in position by fine sutures. I was well rewarded for suturing the little
bowel wall perforation instead of cutting off a small piece of the gut
and re-denuding the mucous membrane. The dog died in some forty-
eight hours from a fæcal fistula occurring at the point where I cut the
little hole with the scissors. This was a death from carelessness Such
holes should not be sutured, but the whole bowel cut away until the
perforation was reached, and then re-denude the mucous membrane
thoroughly. In this case the dog's resistance was not normal from dis-
ease. It was difficult to suture the bowel at all, as it was friable, brit-
tle and easily torn.

Experiment 197 —Dog, female, weight, 6 lbs. A loop of small intes-
tine was drawn out of a median incision and severed completely. The
serous surface on the proximal gut end was scarified and a rubber
tube, three inches long, sutured in it. The mucous membrane of the
distal bowel was well denuded for one-half inch. The proximal bowel
was inserted into the distal bowel lumen, and the circumference of the
distal gut sutured to the serous membrane of the proximal gut. A
graft was fixed in position covering the whole operated parts. This
dog made an uninterrupted recovery, and Dr. Miller took him home
as a pet for his boy two weeks after the operation. Some time after
this Dr. Miller sacrificed the dog for other purposes. He found in the
autopsy some adhesions, the tube gone. The narrowing of the bowel
tube was not very marked from such an operation. The graft was well
and firmly grown, and is in many cases the sole salvation of life in in
testinal operations. At the time of operation this dog was a weak,

scrubby, diseased animal, almost starved, but after the operation, with wholesome food, she gained flesh.

Experiment 195.—Dog, female, young, weight, 10 lbs.   Animal chloroformed, belly shaved, and out of a three inch median incision a loop of small gut was drawn and completely divided. The proximal gut was supplied with a rubber tube, one-fourth by three inches, and its serous surface well scarified. The distal gut was well denuded of its mucous membrane for three fourths of an inch by means of a curved scissors. The fæces in each case were forced in each direction away from the point of division of the bowel, and the parts well protected by compresses of cloth. It was also a point in the operation to see to it that only the bowel operated on was either exposed or manipulated; the rest was pushed back into the abdominal cavity.   The proximal bowel and its rubber tube was now pushed into the lumen of the distal bowel for about an inch.   Then the circumference of the margin of the distal gut was sutured with a continuous Lembert suture to the serous surface of the proximal gut. A large omental graft was well applied and wrapped around the operated parts, and fixed in position by three fine linen sutures. Scarification between the parts operated on and the applied surface of the graft was not always practised, because the operated part of the gut was so much manipulated that it practically equalled a scarification.

This dog made an excellent recovery. From the hour of operation I never saw a bit of difference with this dog from absolute health, for he played just as hard as he could. He ate and drank from the first with a vigorous determination to keep up a long fat future, in which he succeeded, in part.

On the eighth day after the operation I killed him with chloroform because he howled so vigorously as to become a nuisance.   Notice that he played actively, ate voraciously and drank naturally until the day of his taking off by chloroform. The autopsy revealed a curious condition. The dog was kept in a large cellar where straw, coal, etc., lay scattered around. I might remark right here that dogs are subject to enteroliths of various sizes and conditions. I have found them frequently in the dog's intestines. They generally consist of hay, straw, tangled strings firmly interwoven, and in the meshes lie solids of various kinds: This little fellow had swallowed two pieces of coal, one $1 \times 1 \times \frac{1}{4}$ inches, and one $\frac{1}{2} \times \frac{1}{2} \times \frac{1}{4}$ inches. The operation had narrowed the gut lumen probably one fourth of its original size, and these two pieces of coal had lodged against it.   Hay and straw, etc., had also entwined their threads around them until the enterolith was large and

hard. Fluids and gases passed on as fæcal circulation. Violent per
istalsis had progressed for some time for the coal prominences had
formed ulcers in the mucous membrane. One ulcer was three-fourths
of an inch long, and excavated quite deeply into the tissues. Another
ulcer was some one-half inch long and quite deep. It may be noted
that I have allowed liberally for contraction when I say that through
the operated parts the little finger passed easliy. It must not be for-
gotten that the small intestine of a 10-lb. dog is not much larger nor-
mally than a man's little finger.

The graft was perfectly healed, firm and strong, hermetically seal-
ing the whole. The enterolith must have started early, for the peri-
toneum over the operated gut and for about two inches adjacent was
some five times as thick as normal, and the gut was quite congested.
The threads were gradually dropping into the gut lumen. The rubber
tube was gone. But it had disappeared a little too soon, as the end
of the proximal gut had rolled up a little, and caused the previously
described stricture. The union of all the wound was absolutely firm
and solid. The rolled mucous membrane which projected into the gut
lumen had atrophied slightly at its periphery, but would no doubt re-
quire a long time to complete the shrinkage. All the abdominal or-
gans appeared healthy, except the congestion at the seat of operation.
Every operation convinced me that the rubber tube was one of the
essential factors in the operation   Also that the greater part of the
tube should project on the proximal side of the point of operation, and
that it should be so stitched in the gut as to remain three to six days.
The long tube aids in preventing stricture and invagination.

Experiment 246. Dog, female, weight, 25 lbs. After the usual
preparations a loop of small intestine was drawn out of a median inci-
sion and divided transversely. The proximal gut end was scarified
on its serous surface, and a rubber tube four inches long and one-half
inch in diameter was stitched in it with a linen thread. Occasionally
I put two stitches in the tube to hold it longer in its position, and also
it aided in inserting the proximal into the distal gut lumen. The distal
bowel was denuded of its mucous membrane, for three-fourths of an
inch, by means of the scissors and curette. The proximal gut was
then inserted into the distal gut lumen. The circumference of the di-
vided, distal gut end was sutured to the serous membrane of the proxi-
mal gut one inch above its divided margin. A graft was then wrapped
around the operated parts and fixed in position by sutures. The dog
died thirty-six hours after the operation from shock due to hæmor-
rhage.

This taught me a good lesson. I noticed that the dog had full mammary glands, and that they bled very severely at the operation. But I thought the bleeding would cease after closure of the abdominal cavity. Yet the bleeding persistently continued, and in twelve hours the dog had lost nearly a pint of blood, and I thought surely it would cease after that, but those enlarged mammary arteries continued to flow until the dog was simply exhausted. The dog gaped and yawned until death closely followed the end of the red stream of life. The abdominal cavity appeared healthy. The intestines were quite yellow and very pale. The circular enterorrhaphy was healed almost perfectly. The graft hermetically sealed and excellently closed the operated parts, having firm and solid adhesions. The bicornuated uterus contained the remains of six recently delivered zonular placentæ. The operation in this case must be looked upon as a failure from neglect in checking hæmorrhage, and not failure in the seat of operation, for the condition of the operated parts was excellent at the end of a day and a half—a critical time in any intestinal operation.

Experiment 245.—Dog, female, weight 10 lbs. A loop of intestine drawn out and its direction determined. The serous surface of the proximal gut end was scarified an inch, and a tube, one-fourth by two and a half inches, was stitched into it. The mucous membrane of the distal gut was dissected away between one-fourth and one-half inch. The proximal bowel was then inserted into the distal bowel lumen and sutured in position. A graft was carefully applied. The dog died forty-eight hours after the operation from leakage at the point of union of the divided bowel. Cause of death was intestino-peritoneal septicæmia, due to fæcal fistula. The two mistakes which led to death were, first, the mucous membrane was not thoroughly dissected off, and second, the proximal gut was either not invaginated far enough into the distal gut lumen, or it slipped out, and hence caused a fæcal fistula.

Experiment 199.—Dog, male, weight 12 lbs. Operation done as usual, with rubber tube and graft. The dog died forty-five hours after the operation from fæcal fistula at the seat of operation. The parts were not closed with sufficient care.

The above are ten samples of this operation which illustrate its technique, and give some general views of its applicability and utility. The work has taught me that the approach to correct diagnosis and proper treatment of the gastro-intestinal tract in any surgical line requires skill and dexterity, that com-

mon sense and human justice would both dictate should be
acquired at the expense of the life of the lower animals, and
not of that of our fellows.

Operative course upon the cadaver or watching the masters
will neither be sufficient, but to adequately meet these trying
emergencies, and to do the work with that kind of skill and
judgment which defies the criticism of professional witnesses
absolutely demands a certain amount of personal preparation
in experimental lines. I have more than once seen the wrong
tying of a thread kill a dog. A man is just as easily doomed.

The evils to be avoided in this operation on the intestines
are similar to those in any department of gastro-intestinal re-
pair. They are, first, immediate, and, second, remote. The
immediate evil results are fæcal fistula, which invites the
dreaded peritonitis to end the scene. The remote effects are
stricture or such narrowing of the channel of fæcal circulation
as to give rise to obstruction. I have many a time and oft
demonstrated that an artificial fistula made in intestinal anas-
tomosis will contract and narrow from one-fifth to one-third,
and even one-half, of its original size by the end of two months.
These artificial fistulæ are nearly always endowed with a dis-
tinctly sphincter-like condition. The edges or circumference
of the sphincter are thickened and act positively elastic. More
experiments must be carried out to throw light on what will
be the outcome of these fistulæ and strictures. General ex-
perience shows that they gradually but progressively contract.
The strictures from circular enterorrhaphy in my experiments
have acted exactly similar to the artificial fistulæ, but the ex-
periments seemed to demonstrate that stricture from circular
enterorrhaphy was more apt to occur, and also more apt to
contract into dangerous obstruction. This is, no doubt, due
in a measure to the difference of the longitudinal and circular
muscular fibres of the gut. The experiments on animals posi-
tively show that peritoneal plastic exudates are indefinite as
to time and quantity. The exudates may be produced in a
few hours, or be delayed more than a day. Hence, a good
graft is required, and such plates for anastomoses as will last
four to six days, e. g., the segmented rubber or raw hide plates
can be made to absorb at will, as regards time.

During considerable time and a large number of experiments, the results were often marred by what is known as invagination. We lost quite a number of animals after operations on the intestines which, if the invagination had not occurred, would not have died. This induced me to study how to avoid the accident. After considerable experimenting I found that rubber tubing was a definite aid in preventing invagination. At first I used rubber tubes from one to two inches long, but they did not entirely prevent the accident, so finally we adopted the experiment of using rubber tubes, three to four, and even six, inches long. We never had any death from the accident of invagination after we used the long rubber tube. But the main portion of the tube should project above the seat of operation on the proximal side. The tube should remain in position for four to six days. I never saw any obstruction either while the tube was in position or after it had become disengaged from its position. Obstruction and operative procedures are generally accompanied by fluid fæces at the seat of disturbance, so that the fluid fæces would easily pass through the tube. The tube should not be too large in diameter, or it may cause gangrene and fistula by its pressure, but it should be thick enough to keep the gut walls patent, and hold in continuous approximation the healing surfaces. The tube I found good in all forms of circular enterorrhaphy, and in Jobert's operation. The threads were absorbed or worked their way gradually into the bowel lumen. If one bowel lumen is considerable larger than another in performing the above operation the larger lumen could be narrowed by V-shaped incisions, but under such circumstances the intestinal anastomosis by segmented rubber plates or raw hide plates is safer.

A CASE OF PARTIAL EXCISION OF THE STERNUM ON ACCOUNT OF MELANO-SARCOMA.[1]

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WHILE excision of the sternum on account of caries of tuberculous or syphilitic nature has been done quite frequently, excision on account of malignant growths is so rarely performed that neither surgical text-books nor works on operative surgery mention it. By looking over the literature at my command, I find only two cases mentioned, one by Prof. Koenig, of Göttingen, the other by Dr. Kuster. Koenig's case, described in his "Specielle Chirurgie, II Band, p. 51," was an osteoidchondrome which occupied the whole sternum with the exception of the manubrium and the processus xiphoideus. The operation was performed in the following way: Long, vertical skin incision, after which the costal cartilages were severed on both sides from second rib downwards. Thereafter the sternum was cut through by aid of a saw below the first rib. The sternum, with the tumor attached, was now lifted up with blunt hooks and carefully dissected loose from the mediastinum. During this proceeding both pleural cavities were torn open but the tears were closed by pressure with antiseptic gauze till the skin-flap was in position covering the openings. The tumor was adherent to the pericardium, which was removed with success (?). The patient recovered, but died two years later from relapse in the lung. I have been unable to find the report of Kuster's case, but desire to publish a third

[1]Read before the New York State Medical Society, Feb. 3, 1891.

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case which I have lately operated. Mary F., æt. 20 years, born in Ireland, entered the Sisters of Charity Hospital on November 14, 1890, with the following history: She is a domestic, and has been obliged to do a great deal of sweeping, during which the handle of the broom rubbed against her breast bone. She ascribes her complaint, a tumor over the sternum, to this cause. The tumor first appeared eleven months ago, and has been growing larger steadily until now it is the size of half an orange, and extends from below second to below fifth ribs. Four months ago the glands in the right axilla commenced to enlarge and there is now found here a conglomeration of glands as large as two fists, completely filling the whole axilla but yet somewhat movable. Two months ago the glands in the left axilla commenced to swell, and are now as large as a hen's egg. During the last few weeks the glands in both supraclavicular regions have commenced to enlarge. The tumor over the sternum is immovable, presents a feeling of false fluctuation, the skin is normal in color and not adherent. She has sharp, shooting pains radiating from the tumor in different directions; has lately commenced to lose flesh, but is yet in pretty good general health. There are no symptoms of any growth in the anterior mediastinum such as hoarseness, difficulty of breathing or interference with circulation. November 15, 1890, operation under ether-narcosis.

U-formed incision, convex downwards, from second to sixth ribs, about 3 inches wide. The flap was dissected up and the periosteum loosened transversely from the sternum above the tumor in healthy tissue in order to shell out the tumor from the bone, if possible. The tumor was surrounded by a strong, fibrous capsule. On a line of the fourth rib the tumor extended into the sternum, and the capsule was necessarily opened here, and there was a discharge of a semifluid, black, grumous substance. The rest of the tumor was therefore removed from below upwards, by a similar process. The sternum was found quite extensively involved, presenting an irregular cavity as large as a section of a hickory nut, filled with the black, grumous substance. It was thoroughly scraped out with a sharp spoon. During this proceeding, the posterior lamina of the sternum was perforated. The opening was enlarged with chis-

els and from this opening the posterior periosteum was loosened
with a curved elevator, and the sternum removed piecemeal
with cutting pliers from above the third rib to midway between
fifth and sixth ribs.   About $^1/_2$ inch of third, fourth and fifth
right costal cartilages were removed too, and the pericardium,
which appeared healthy, exposed for about 6 square inches.
The skin flap was thereafter brought into place, sutured, and a
drainage-tube inserted from the lowest point into the cavity
left by the removal of the tumor and the sternum.   The en-
larged glands were thereafter removed from both axillæ and
supraclavicular regions, drainage-tubes or catgut drains intro-
duced, sutures inserted and antiseptic dressings applied.   The
operation lasted two and one-half hours.

The further course was favorable.   The temperature rose
for a couple of days to 101° in the evening.   The respiration
was difficult and painful for some time till she learned to use
abdominal respiration.   The drains were removed on fifth day,
and on the tenth day the wounds were healed and the patient
allowed to sit up.   She left the hospital on the fourteenth day,
and so far, ten weeks after the operation, no symptoms of re-
lapse; has gained 12 pounds in weight, and gone to work again
as a domestic.

The operation performed differs from the one described by
Koenig.   He tried to extirpate the sternum in toto, and man-
aged by that proceeding to tear open both pleural cavities.   It
is scarcely possible to have this accident occur when we first
trephine the sternum, and then remove it in pieces with cutting-
pliers.   I could, with the greatest ease, have removed the
whole sternum in this way but stopped, of course, when I met
healthy bone-tissue. The tumor, being a melano-sarcoma, will,
of course, return, and eventually kill the patient, but if it had
been removed half a year earlier, before the glands were en-
larged, there might have been better prospects of a permanent
result.   I was severely criticized by several physicians for at-
tempting the removal, they being of the opinion "that such an
operation was little short of murder."   In short, the only men
who sustained me and advised the removal were Dr. John
Cronyn, who sent the patient to me, and Dr. W. H. Heath, both
my colleagues in the Sisters' Hospital.

I add the report of the microscopical examination by Dr. W. C. Kraus, lecturer in pathology at the Niagara University:

REPORT OF PATHOLOGIST.

The specimen delivered to me by Dr. Mynter was an irregular, unsymmetrical mass of tissue, weighing about one-half to three fourths pounds. The central portion was of a dark brownish color while the borders assumed a pinkish appearance and in consistency soft, save here and there some small, hard, nodular masses which were distinctly tangible. The body of the tumor was encised in a dense, fibrous capsule, which, on opening, contained a thick, dark colored, grumous mass. The small nodules on section presented a pearly white cartilaginous appearance.

Scrapings from the central mass examined under the microscope without staining, showed the presence of small, round, granular cells, with dark-brown pigment bodies.

Small particles from the different regions were hardened in alcohol, imbedded in celloidin, and sections examined with a Zeiss C, No. 2 eye-piece.

The central mass was similar in structure to the scrapings from the fresh specimen, viz., the small, round, granular cells and the dark-brown pigmented bodies, showing it to be unmistakably a melano-sarcoma.

The hard, oval bodies situated in the periphery of the mass presented, in all respects, a cartilaginous appearance and must be re garded as enchondromas. Some of the surrounding tissue which was free from pigment showed predominance of fibrous tissue elements interlaced between small granular cells, and is of the fibro-sarcomatous variety.

The mass, as a whole, is, therefore, in all probability a mixed sarcoma, melanotic, cartilaginous and fibrous tissue being present in great abundance. The bulk, however, is of the melanotic variety, and the tumor may, without hesitation, be termed a melano sarcoma.

A CASE OF ŒSOPHAGOTOMY FOR REMOVAL OF AN IMPACTED FOREIGN BODY.[1]

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NOVEMBER 28, 1887, Mr. W., a medical student, being in haste to return to lectures, while eating lunch attempted to swallow quite a large piece of meat without having properly masticated it. The piece stuck on the way and would not go down nor come up. His distress was accompanied with difficulty in breathing, as well as inability to swallow anything except a small quantity of liquid, and that seemed to go down, as it were, drop by drop He felt a pricking and a stinging sensation in the lower part of his neck, just above the sternum. His suffering and anxiety were very great. He was in dread of an operation. Yet he felt that his case was very serious without operative interference. On the following day, his suffering having increased, he consulted Dr. T. R. French, who found the foreign body in the œsophagus, between the cricoid cartilage and the sternum. The offending body was so firmly impacted that every reasonable effort to remove it failed; it could be siezed with the œsophageal forceps, but could not be pulled out. An anodyne was administered, and the patient went home, hoping to avoid an operation. On the following day, another attempt made by Dr. French to remove the offending body did not succeed. Mr. W. then went home, still having the idea that in some way he could get along without an operation. On December 2, Mr. W.'s wife saw Dr. French, and informed him that her husband was rapidly getting worse. She said that he was suffering from thirst, hunger, pain and anxiety. Again Dr. French urged the necessity of an operation; and affirmed that delay was attended by imminent peril.

[1]Read Before the Brooklyn Surgical Society, December 4, 1890.

On the afternoon of the same day, December 2, I saw Mr. W. with Drs. French, Rockwell, Murray and Cochran, for the purpose of operating. The patient was in a small house, whose windows on the north side admitted only a small quantity of light. On the south side there was an elevated railroad that shut out the light quite completely. The room was very small, not being large enough for the surgeons to move freely about the patient as he was lying on the table for operation. The afternoon was gliding on rapidly, so that it was necessary to make as much haste as possible, in order to avoid the use of artificial light.

The patient was suffering from both hunger and thirst; he was emaciating rapidly; he had become somewhat indifferent; his neck was swollen—most on the right side; and pressure on this part appeared to reveal a point of greater resistance: The point was between the cricoid cartilage and the upper end of the sternum.

After every preparation had been made for an operation, a final attempt was made to dislodge the impacted body; it was completely immovable. Then I proceeded to perform œsophagotomy on the right side of the neck. This side I selected for two reasons: I thought the impacted body was more prominent on that side than on the left; I could not, on account of the room and the light, put the patient in a position to get a good view of the left side of the neck. The room was very small, and the light was not good. After the etherization, an attempt to introduce a sound, so as to enable me to cut down on the point, completely failed; the instrument would not enter the œsophagus. Then I made an incision about 4 inches in length along the inner border of the sternocleido-mastoid muscle, going down as rapidly as possible between the trachea and the great vessels of the neck. The hæmorrhage was controlled with hemostatic forceps, pressure of the fingers, and broad retractors. The great blood vessels and the pneumogastric nerve were drawn outward. The right lobe of the thyroid gland was so long that I cut through it. The retractors applied to the cut surfaces arrested the flow of blood. I pressed the soft parts outward till I could feel the cervical spine. Then I made an incision about midway between the vertebral bodies and the rings of the trachea, when I could feel the sharp point of something pressing against the wall of the œsophagus. A little dissection showed me that it was a sharp point of bone. A probe pointed tenotome was introduced through the small opening, which was enlarged upward until a pair of forceps enabled me readily to extract the impacted body. It was a piece of the spinal end of a pig's rib, cut off obliquely, so as

to make it somewhat conoidal in shape.   It was an inch in length; its apex was very sharp and pointed; its base was over one-half an inch in width, and had a sharp process projecting from it.   This process had been imbedded in the left wall of the œsophagus, while the sharp-pointed apex was piercing the right wall.   Then it was easy to see why the impacted bone could not be removed with the œsophageal forceps.   The opening into the œsophagus was a little more than one-half inch in length.

When the operation was about half done, the day-light became so obscure, that a lamp was brought in order that we might see.   The depth of the opening in the neck and the shadows cast by the lamp augmented the difficulties of the operation.   At one time bubbles of air came from the lower and deepest part of the wound; the air had been imprisoned by a valvular flap of the soft parts.   The condition of the patient was good.

FRAGMENT OF BONE REMOVED BY ŒSOPHAGOTOMY.—*Full Size.*

My idea was to bring the edges of the wound in the œsophagus to-gether with catgut sutures, and obtain primary union.   Then I could have closed the rest of the wound with deep sutures, so as to have prevented inflammation and suppuration.   Yet it was thought best to pursue the usual course.   After the insertion of suture-ligatures in the oozing thyroid tissue and the ligation of some bleeding points, a tube was passed into the œsophagus through the opening whence the piece of bone had been extracted; this was a rubber tube, having a rather small hole in it.   Then the wound was brought together with super-ficial sutures, two drainage-tubes being inserted.   An antiseptic dress-ing was applied over all.   The patient was put to bed, passing a comfortable night, and the next day he was conveyed to the College Hospital, in order that he might have the best attention and care.

The after-treatment may be summarized as follows: The feed tube produced some irritation, and was not very efficacious for introducing nourishment.   Some of the milk that was poured into it would re-gurgitate and come out of the wound through one of the drainage-tubes.   The patient could take a little milk by the mouth, and swal-

low it once or twice a day; this appeased his thirst to some extent.
The essential part of the feeding was by the rectum; once or twice a
day he had an injection of one or two ounces of milk, or concentrated
beef juice, or pancreatic emulsion. In the feeding of my patient, Dr.
French rendered valuable assistance. At times the rectum would be-
come irritable and reject the introduced nourishment; the irritability
would not last longer than 12 or 24 hours. Occasionally I removed
the feed-tube and cleaned it. At the end of ten days I took it out and
did not replace it. Then the patient began to take more milk the
natural way; this appeared to satisfy his thirst and hunger to some ex-
tent. On December 16, he was sent home in a very much improved
condition, the wound having healed. Then he was taking liquid
nourishment in a very satisfactory manner. After one year his recovery
appeared to be perfect. He had only a small scar on his neck, and
deglutition was entirely without impediment.

Finally, the reasons have already been given for operating on the
right side of the neck, and comment is not needed. The suggestion, as
to the closing of the cut in the œsophagus, seems to be in the right
direction. I am convinced that my patient would have done better, if
I had not used a feed-tube. If the sound could have been put into
the œsophagus, so that I could have cut down on the point of it, the
wound of operation would have been less formidable. I may say,
that I hurried through the operation, that is, I did not stop at any step
of the procedure.

A CASE OF BRAIN TUMOR.[1]

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MALE, æt. 52 years. Until recently railway conductor; of late commercial traveler. First wife died about eighteen months ago. Remarried ten months ago. Had with first wife five children, of whom four are living, the oldest æt. 23 years, the youngest æt 13 years. One daughter died of pulmonary tuberculosis. Patient given to excessive indulgence in tobacco-chewing constantly, and rarely ex-pectorating the juice; and also to great venereal excess. The death of his first wife was very sudden and unexpected. Though having suf-fered from a cardiac lesion for years, she retired in her usual health at night. At 3 o'clock in the morning her husband was awakened by her labored breathing, and before medical aid could be obtained she died.

On the afternoon of July 24, 1890, the patient with his wife and youngest child were at the Thousand Islands in a row boat. As the boat was nearing the shore the patient felt his left arm suddenly drop to his side, and realizing that he was unable to manage the boat called loudly for help. His son, as noted, a boy of 13, is certain that his father shook convulsively. The wife in the excitement of the moment did not notice. With the help that came to them, the boat was brought to the shore. The patient had not lost consciousness. The loss of motion in the arm was temporary. He was soon able to move about, and indeed walked to the further end of Round Island, a dis-tance of perhaps three quarters of a mile, to consult a physician. .The attack was considered to be one of sunstroke.

From this time on until the patient consulted me, which was on August 10, 1890, he had repeated attacks not of loss of motion, but

[1] Read at a meeting of the Syracuse Medical Association, December 2, 1890.

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of clonic convulsions of the left arm. Each attack, he thought, continued for about five minutes, and they recurred sometimes several times a day, and again but once daily; or there might be an interval of several days between them. Otherwise he felt well enough to pursue his vocation, which necessitated his making short railway trips. He ate well, but did not sleep well.

About 3 o'clock each morning, the hour, as he put it, at which he found his wife dying, he would be awakened. If at this time he had no convulsion he would frequently get up, dress, go down stairs, and read. Examination failed to reveal, August 10, 1890, any signs of weakness in the left arm, any disturbance of the reflexes, or of vision. There was not, nor had there been, any headache. The patient did not recall at the time ever having sustained any injury to head. He never had otorrhœa, nor any other suppurative affection. The urine was examined, but aside from a very low specific gravity, it was normal.

With the absence of any positive signs to indicate an organic disturbance, and with the evidence of habits and a state of mental agitation that might account for possibly a chorea, the patient was put upon bromides, and advised to discontinue the use of tobacco and avoid venereal indulgence.

However, despite this line of treatment the condition did not improve. The convulsive attacks were if anything more severe. Mild doses of strychnia and galvanism applied with the positive pole to the back of the neck and the negative held in left hand increased the frequency and severity of the seizures.

August 28, 1890, the patient complained that the left leg exhibited also clonic movements, not as severe, but occurring synchronously with those of the arm. Until now the patient had felt absolutely well after the attacks, and in the interim between them. About this time he noticed that upon arising he could not readily gain a footing. He felt inclined to turn around several times before he could gain his equilibrim. The left arm and hand now became slightly enfeebled.

The patient at this time as on previous occasions denied absolutely the possibility of any syphilitic infection. He was notwithstanding put upon the potassium iodide in ten grain doses in connection with a similar dose of the bromide of potassium.

Three days later he was awakened at 3 A. M. with the most severe convulsion he had had. Immediately thereafter there was evident paresis, of a mild type, of both the upper and lower extremities of the eft side In walking he would swing his leg describing a circular

movement instead of projecting it directly before him.   For a week he had no further convulsion.

At this time, September 7, 1890, it was very evident that the paresis was deepening into a decided paralysis.   The patient had been able until now to come to my office; but his family realizing his growing loss of motion had recently not allowed him to go unattended.   The iodides produced such sharp catarrhal symptoms of the nose and eyes, and as no benfit attended their use, they were discontinued.   The patient manifested no muscular incoordination nor had there been, though frequently searched for, any sign of facial paralysis.   During the night of September 13, 1890, he had his last convulsive seizure. Four days later, for the first time, he complained of headache.   The cephalalgia was limited to the right temporal and frontal regions   It grew most intense, of a boring, clutching, twisting character as the patient described it.   It was so severe that merely touching the bedding or moving the patient greatly aggravated it.   At first it was controlled by phenacetine, antipyrine and the bromides; but later only opiates afforded relief.   He lay with his face buried in the pillow, with the room darkened, and the utmost quiet had to be maintained about him.   This pain persisted for two weeks.   During this period it was evident that the paralysis was deepening.   When on September 27, 1890, the pain ceased and he was again able to sit up, it was too plain that not only was the left upper extremity completely, and the left lower nearly paralyzed, but also that the left half of the face had now become similarly affected

During the entire sickness the temperature was closely watched; but never, at any time, was there any suggestion of fever.

The absence of fever, of any etiological data to account for the presence of a brain abscess, the steadily progressive signs of brain compression, made it altogether probable that we were dealing with a brain tumor.

Careful examination of the scalp brought to light a scar close to the median line and situated about an inch anterior to the binauricular line.

The patient had forgotten until reminded by his brother that in 1866 he had received a blow upon his head from a falling timber; but the location of this scar did not correspond to the area of the brain probably involved   The presumption was that a growth existed in the right motor tract, and that assuming that the initial symptoms marked the site of its beginning. that it commenced in the center of the right ascending frontal convolution, spread at first upwards, involving

the upper third of the ascending frontal and parietal convolution, and later reversing its course proceeded downwards and attacked the convolutions at the lower end of the Rolandic fissure. The very rapid progress was strongly suggestive of a malignant and infiltrating tumor.

Holding to this view I could not urge an operation with any assurance of a successful issue. However the utter hopelessness of the case under simply medicinal treatment induced me to strongly impress upon the family that in surgical measures alone lay the only hope of relief.

Dr. H. D. Didama, who saw the patient September, 28, 1890, concurred in my diagnosis, and suggested a return to the antisyphilitic treatment. The iodide was rapidly crowded to 30 grains three times daily, and one drachm of mercurial ointment was thoroughly rubbed into the patient morning and evening. The bowels were kept open with either Rochelle or Epsom salts.

For a few days the head was very free from pain. His mental condition improved. The pulse which all through had ranged from 60 to 66 increased to 78. But on October 4, 1890, the patient became quite somnolent. The paralysis of the lower extremity was all but complete, slight motions of the foot alone responding to hard punching of the leg.

On October 6, 1890, the patient's somnolence amounted almost to coma. The pulse beats numbered 90. The urine was occasionally voided in bed. Deglutition was tardy, the patient holding fluids in his mouth for some time, before swallowing them. His speech was not as intelligible, and a mild delirium of muttering character appeared.

On the following day the breathing though regular was stertorous. Moderate internal strabismus of the eye appeared. Unless a great effort was made to arouse him he remained in this comatose condition. A finger carried into his mouth found in the pharynx several grapes that had been lodged there for a day or more.

On October 9, 1890, all the urine was voided unconsciously while the patient lay in deeper stupor than ever, and the breathing was very stertorous. Yet on the next day he exhibited a wonderful return of mental activity, intelligently taking part in conversation. He drank freely, holding the glass himself and carrying it to his lips. Indeed his family were sufficiently encouraged by this improvement to reconsider their former objections to any operative interference. The paralytic condition exhibited no change.

The amelioration however was so very transitory that it was deemed

unwise to open the skull. Octobet 11 found him with a little return of pain in the head, lessened mental vigor, deepening somnolence, and involuntary action of the bladder. The temperature remained normal.

October 13, there was a suggestion of the Cheyne Stokes respiration, and a protraction of some of the pulse beats; on the 14th, deep coma set in. A slight rise in temperature to 99.5° occurred. He could no longer be aroused to take any nourishment. The indications of deep compression deepened, and the patient passed quietly away on the 16th.

Autopsy held October 19, 1890. Present, Drs. Didama, Sears, Magee, Moore and myself. Before beginning the post-mortem examination, that I might see how well I had located the tumor, I outlined the fissure of Rolando, and carried an awl through the skull into what was presumably the centre of the ascending frontal convolution and also what should be the upper and lower limits of our growth.

The incision of the scalp was made from mastoid to mastoid. The skull-cap removed. On the right side of the brain, corresponding to the junction of the parietal and frontal convolutions was a marked bulging, perhaps 3 inches diameter. Upon palpation the mass was soft, the elasticity very suggestive of fluctuation. Upon the vertex, about the site of the bregma, the two halves of the cerebrum were held together by an adhesive meningitis—presenting an aggregation of minute tubercles. Along the vessels of the pia, turbidity existed and fluid was present in the arachnoid to an abnormal extent. Enough of the pia was removed from the site of the projection to show the surface of the convolutions which presented no discoloration.

The cerebral hemispheres were separated. As the longitudinal fissure was spread out, on the inner portion of the right hemisphere, corresponding to the site of the growth, could be seen a mass, redish gray in color.

It should be said that with the awl I had absolutely located and outlined the tumor.

An incision was now made through the corpus callosum, perhaps $^1/_8$ of an inch to the right of the middle line, and the right lateral ventricle exposed; a very slight increase of fluid was found here. The finger was carried into the anterior horn of the right lateral ventricle, and with a scalpel the right frontal lobe was incised. The posterior horn was similiarly treated.

The two incisions were united by longitudinal ones. Now, there came to light a soft infiltrating tumor with its outline fading into the white brain tissue; its borders red or reddish gray. Its centre in a process of softening, partially excavated and presenting a grayish or even

greenish discoloration. Towards the surface of the cerebrum it spread out and presented its greatest diameter. The growth was oval, antero-posteriorly nearly 3, and vertically 2 inches in diameter.

The site of the greatest degeneration, and probably, therefore, of the greatest age, or in other words, the starting point of the growth, was in the centre of the ascending frontal convolution. This point was exactly indicated by the awl.

A corresponding point of the ascending parietal was involved as was also the upper part of these convolutions and also their lower third, but less extensively. The growth extended from within one-half inch of the surface of the cerebrum almost to the corpus callosum.

The left lateral ventricle was opened. Here there was more fluid than in the right one, while the choroid plexus was so œdematous that it almost seemed to have undergone cystic degeneration.

Dr. F. W. Sears has carefully examined the tumor microscopically, and finds it to be a glio-sarcoma.

REMARKS.

In the consideration of this case there are two lines of inquiry to be pursued: first, that pertaining to the diagnosis; and second, that of treatment.

In reaching a conclusion as to the character of the affection, we were in the earliest period of the disease confronted with the question, "Are we dealing with a series of nervous explosions which express only the patient's reduced nervous tone, or is there an organic cerebral disease?"

The patient's habits, the recent unexpected death of his wife, the recurrence of nervous manifestations at the exact hour of her demise, gave color to the theory that the trouble might be only hysterical.

But the steady progression despite the enforcement of restrictions and the administrations of remedies that should have controlled the manifestations, had they been only of functional origin, forced upon the medical attendants the conclusion that there must be an organic lesion to explain the trouble.

What data had we to establish exactly the particular nature of the lesion? Let us remember that we were dealing with a case which was making very rapid progress. From the very earliest manifestations at the close of July until the autopsy was held less than three months intervened. The symptoms

early were those of brain irritation; late, those of brain compression.

They were not sufficiently violent nor rapid to speak for an inflammatory affection. It was rather evident that we were dealing with a pathological change within a limited area of the brain and that in all probability it must be either a brain abscess or a tumor.

With either there would be an increased intra-cranial pressure and, depending upon the site, there would be given signs by which we might localize the lesion.

To reach a differential diagnosis between the two, it is necessary to study more closely the history of the case, *i. e.*, in its etiological bearings, the course of the disease and the constitutional manifestations.

It is recognized to-day that primary idiopathic abscess of the brain does not occur. Suppuration here may either follow a trauma and indeed one in which there is laceration of the soft tissues, or be secondary to some existing suppurative affection.

Under the latter head, otitis media is the most frequent source of infection. Yet empyema, gangrene of the lungs, bronchiectasis or some other remote suppurative disease may awaken metastatic abscess of the brain. Nothing of this kind was present in our patient.

Von Bergmann, who has recently given us a really classic work upon the operative treatment of brain diseases, lays great stress upon the etiological element in reaching a diagnosis. Wernicke, a recognized authority on brain diseases, had diagnosticated a case as brain abscess and referred it to Von Bergmann for operation. This the latter refused to do, simply because there was no evidence of pre-existing trauma or suppuration. A few days later the patient died, and the good judgment of the surgeon was borne out at the autopsy. As the disease proved to be an extensive inoperable infiltrating brain tumor.

Secondly, there was no evidence of constitutional disturbance such as we would expect to find with pent up pus. The symptoms throughout were merely those of compression and never of pyemic infection.

At no time did the patient have either chills or fever. The temperature was taken at various times of the day, but until towards the very close was found to be absolutely normal. There were no digestive disturbances. No morning improvement nor evening depression, or aggravation of symptoms; no loss of appetite until within a few weeks of his death. In fact, the patient persisted, until the compression symptoms were too profound, to assure me that he felt well. These two considerations it seemed were sufficient to exclude brain abscess.

And yet the very rapid progress of the case made me hesitate at first in establishing a positive diagnosis. As far as I know, our case is a unique one in this regard. Almost all of the cases of brain tumor, which have been operated, and certainly those which have been successfully so, have in their history covered a period of years rather than months. I have read extensively, but find no brain tumor described, with so short a period of existence.

The early absence of headache, the almost never failing sign of intra-cranial pressure, and especially on its occurrence, the absence of fever, was unlike the expression of brain suppuration.

Percussion of the head produced pain just as it might with abscess. In both affections the pulse may be slow and labored.

It is said that the sudden changeability of symptoms is more characteristic of abscess. Yet in no case could there have been more marked changes than were often apparent in our patient in the course of twenty-four hours. One day in deep stupor, with urine being discharged unconsciously, and on the next engaging in conversation apparently with a clear mind.

H. C. Wood, in illustrating the point that the stupor of brain tumor may pass off rapidly, refers to a patient he had seen with a gliomatous tumor, absolutely comatose for several days, passing his discharges involuntarily and thought to be dying, a few hours later walked to the clinic room in a distant part of the hospital.

I regret extremely the failure to make an ophthalmoscopic examination in this case. For although optic neuritis is much more commonly encountered in cerebral tumor, the review of cases shows that it is by no means always absent in brain ab-

scess. Yet J. Hughlings Jackson remarked in an address published in the *British Medical Journal*, July 21, 1889, "I have not yet seen a case followed by necropsy, the two symptoms, the epileptiform seizures and double optic neuritis coexisting, in which I did not find cerebral tumor."

That it is impossible to localize a tumor situated in the motor area is generally conceded. It is, however, a much more difficult matter to determine the character and extent of the brain tumor.

Von Bergmann insists that we have no positive signs for establishing these points.   Should it be of tubercular character as a majority of these tumors are, there will in all probability be tubercular disease of other organs to suggest the diagnosis.

It goes without saying that a thorough anti-syphilitic treatment should precede any determination to treat the case surgically.   Nowhere in medicine does medicinal treatment more promptly accomplish its purpose than in the dissipation of syphilitic brain disease.

The period of time occupied by a tumor in its development is not to be overlooked.   If, as in our case, it has grown rapidly, as is evident in the number of new brain centers that are speedily involved, it is apparent that there exists no well defined investment; but that the tumor must be of an infiltrating character.

I listened with great interest to the enthusiastic Keen, as he opened the discussion, in October last, at the meeting of the New York State Medical Association, on the diagnosis and surgical treatment of brain diseases, pleading as he did that in the light of recent advance, the cranial cavity should be invaded as freely as the abdomen is to-day.

If the teaching of Tait, that we are first to open the abdomen, and then make our diagnosis, is to be applied to the head, I fear much more harm than good is to come to the unfortunate patients affected with serious brain lesions. One cannot help be impressed with the searching study Von Bergmann has made of the 100 cases of brain tumors reported by Hale White as having been seen at Guy's Hospital between the years 1872 and 1884. Based entirely upon the post-mortem findings, 9 of the 100 cases could have been removed successfully. But as 9 of these 7 manifested no special symptoms by

which they could have been recognized during life, the number of operable cases was reduced to two. For this reason, Von Bergmann speaks discouragingly of the future of the operative relief of brain tumors, and lays down the rule that he who is to operate a brain tumor must know more of it than its location; he must also be certain that it can be enucleated.

And yet within a few years there have been, comparatively speaking, a great number of successful operations. So that I cannot but believe that with more exact methods of diagnosis a new field of legitimate work may open before us.

But with symptoms of deep compression, unconsciousness, coma, Cheyne Stokes breathing, no one would justify an operation. And as these symptoms rapidly presented themselves in our case while, prior to their appearance, I was indeed anxious to operate, with their coming I promptly abandoned the thought.

The autopsy showed how impossible would have been its removal.

EDITORIAL ARTICLES.

MELCHIOR ON THE CONSERVATIVE TREATMENT OF HÆMAR-
THROSIS OF THE KNEE-JOINT.[1]

There are, at the present, two methods of treatment of hæmar-
throsis of the knee-joint: the operative and conservative methods.
Formerly, during the pre-antiseptic period, there was no doubt as to
the choice; indeed, there was then but one mode of treatment, viz.,
the conservative, for no one would have been so foolhardy as to
attempt a dangerous procedure while the conservative treatment
offered quite a certainty of success. Jarjavay, in 1863, tried puncture
of the knee-joint, but this found only few advocates, as the dangers
were great and the results doubtful. With the introduction of antisep-
sis this procedure was accepted and recommended by such men as
Volkmann and Schede, as well as by Esmarch, König, Kocher, Broca
and Sabbe, and everywhere gained ground at the expense of the con-
servative method.

In Scandinavia, as well, a change occurred in favor of treatment by
puncture. Already in 1871 Ludv. Jacobson[2] published two cases,
successfully treated by puncture, without irrigation, and in 1880,
O. Lecher (*Hospitals-Tidende*, 2, R. viii, No 27) communicated a
series of seventeen cases from the "Kommune-Hospital" in Copen-
hagen, in which he had employed puncture followed by antiseptic irri-
gation, with satisfactory results. While Jacobson's advocacy of this
method is apparently not even warm, Lecher, on the contrary, con-

[1]Dr. Max Melchior, of Copenhagen, *Hospitals-Tidende*, 1890, 3. Rakke, viii,
26 and 27, pp. 653 and 682.

[2]Behandlingen af Ansamlinger i Knæleddet med Punktur og Stivelse-Bandage
(Treatment of Effusions into the Knee-Joint by Means of Puncture and the Fixation-
Bandage), *Ugeskrift f. Læger*, 3, R. xi, No. 6 and 7.

cludes that it will be of service in large hospitals, but will hardly be
accepted as the general method. Finally, in 1886, Dr. J. Bondesen,
having more material at his disposal, made a comparison between the
results of the conservative and operative treatment. He arrived, as a
result of his investigations, at the conclusion that treatment by punc-
ture gave a shorter and more rapid course of the disease, and a more
complete recovery than the older conservative method. Dr. Bon-
desen's cases were. however, taken from an epoch when the means
used by the author (epithemata, compression, immobilization, etc.)
were not employed. Therefore one can only decide as to whether
puncture is preferable to the earlier method of conservative treatment,
but the question of "puncture or not?" still remains open. The writer
has, therefore, collected all the cases of hæmarthrosis which had been
treated by Dr. O. Bloch in the "Frederick Hospital" (Copenhagen),
during the last four years. In accordance with the general acceptation
of to-day the diagnosis of hæmarthrosis was made in every case of
acute traumatic collection in the knee-joint, excluding, of course, those
cases where hæmarthrosis was a by-symptom of some simultaneously
existing greater lesion, *e. g.*, fracture of the patella. It may be, indeed,
very difficult or even impossible to make a diagnosis of uncomplicated
hæmarthrosis for under this clinical picture the most varied forms may
conceal themselves, as the distended capsule renders examination of
the inner portion of the joint so difficult that lesions (*e. g.*, a little fis-
sure, an intra-articular fracture, a contusion or a fracture of some
osseous portion, a lesion of the intra-articular cartilages or of the inter-
nal ligaments) may be present, and only recognized in the later course
of the case. The writer then analyzes his material and compares it
point for point with the cases of Dr. Bondesen, which were treated by
puncture.

In all, during the time mentioned, forty one patients had been
treated for hæmarthrosis, but as two were punctured only thirty-nine
remain for comparison. Two of them were women, the remainder
men. For the greatest part they were working men or sailors from
20 to 50 years of age; four of the patients were over 50 and four under
20 years old. The cause has most often been a fall, a kick, a blow,

a jolt or some similar accident; but in not less that nine cases had distortion occurred. The majority of them entered the hospital on the day following the injury. In seven cases an increase of 3 cm. in the circumference of the knee was observed; three cases presented effusion with no increase in size. Five cases had to be excluded in the comparison, on account of complications. There remain, finally, thirty-five cases of Dr. Bloch to be compared with fifty-seven cases of Dr. Bondesen.

1. Fifty-seven cases of hæmarthrosis of the knee-joint treated by punctures and subsequent antiseptic irrigation yielded, on the average, a period of treatment, counting from the day of the injury, of 24 3 days; reckoning from the day of entrance into the hospital of 22.4 days.

Of these 57 cases, were discharged as completely cured, 49; as incompletely cured, or where treatment was interrupted, 8.

2. Thirty-five cases of hæmarthrosis of the knee-joint, treated conservatively, counted from the day of the injury, yielded on an average 19.06 days; reckoned from the day of entrance into the hospital 16.11 days (on an average). Of these 35, were discharged as completely cured, 26 as improved, 9.

Those discharged as cured had a normal condition of the knee, no effusion, no pains and good functions of the joint. A slight collection or effusion with even good function and a completely free gait were regarded as sufficient reasons to put the patient under the "improved" and not the "cured" rubric.

Of the 9 patients which left the hospital "improved," 8 were discharged at their own demand, simply because they felt well enough to go about. In all these 9 cases there remained a slight effusion, but motion, as a rule, was good. If, however, only the completely cured be compared, there results for treatment by puncture an average period of treatment of 21 30 days; while for the conservative plan an average of 18 days is obtained.

1. Of the 49 cases treated by puncture there were discharged before the twentieth day, 53%; after the twentieth day, 47%.

2. Of the 26 cases treated conservatively there were discharged before the twentieth day, 73%; after the twentieth day, 26.9%.

There can be no doubt as to the advantages of the conservative method.   The period of treatment, reckoned from the day of entrance; is, in all cases, 6 days longer under treatment by puncture than by the conservative method.   Yet these figures are not as complete as at first sight they might seem, as the number of those for a short time under treatment is quite large and by itself would reduce the favorable difference between the two methods.   One, however, can obtain a better standard by only comparing the completely cured cases.   Here a surprising difference can be formed; the average time being over three days shorter in favor of the conservative method.   Again, one sees that not much more than half of the cases treated by puncture were discharged before the twentieth day, but none before the tenth day.   By referring to the other group of cases, *i. e.*, those treated conservatively, we see that nearly three-fourths (75%) were discharged before the lapse of twenty days' treatment, and not less than five before the tenth day (one after six and two after eight days).   Of the completely cured cases seven were under treatment over twenty days and two over thirty days.   The cause of these deviations from the general rule may be easily seen in most cases.   Where for a long time, in spite of all treatment, there remained a sensitive spot in some circumscribed part of the bone one may assume that a contusion of the bone, perhaps with formation of a fissure, existed as was seen in several cases.   The writer would presume a lesion of the internal lateral ligament to have been present in those cases where treatment extended beyond the ordinary length of time.   One case had before had hæmarthrosis of the same joint, to which circumstance must be attributed the longer course of this particular case.   One of the writer's cases was remarkable in that it presented an extensive coagulation of the contents of the capsule, which is certainly quite rare in an uncomplicated case of hæmarthrosis.   Volkmann's experience (Zur Punktion des Hæmarthrus, *Centralblatt f. Chirurgie,* 1880. No. 10) goes to show that the blood within the capsule remains liquid the first three days and even on the fourth to the eighth day the principal mass of the blood is uncoagulated.   Secher's (*Loc. Cit.*) and Piéchand's (De la Punction et d'incision dans les maladies articulaires, Paris, 1880,)

investigations, also, confirm this view.   Bondesen (*Loc. Cit.*) empha-
sizes especially that coagulation within the first four days after the oc-
currence of the lesion belongs to the rarest exceptions.   According to
Kocher's view (*Centralblatt f. Chirurgie*, 1880, No. 20,) the coagu-
lation-inhibitory action of the synovial membrane may be modified
under certain conditions, especially if the anterior portion of the cap-
sule of the joint be in communication with wound-surfaces (according
to Riedel, "Verhalten von Blut in den Gelenken," *Deutsche Zeitschrift
f. Chirurgie*, bd, xii, p. 447), upon which coagulation rapidly begins
and thence extends through the blood extravasate within the capsule.
But for comparison these seven complicated cases should be excluded,
and the average time of treatment required to establish a complete
cure was, therefore, fourteen days, which means a saving of one week
by the employment of the conservative method.   The number of the
incompletely cured is quite considerable, but this is due to their leav-
ing the hospital early, on account of their feeling well enough to be up
and about; the effusion, however, having not yet entirely disappeared.
As none of them ever returned one may safely assume that they ulti-
mately recovered entirely.   None of the cases became chronic nor was
there hydrarthrosis or relaxation of the ligaments, which are said to
follow treatment by the conservative method.   None of the cases
treated by Dr. Bondesen by puncture ran into chronic hydrarthrosis.
The writer also treated two cases by puncture.   One of these recov-
ered after eighteen and the other after forty-seven days.   Both, how-
ever, presented, after recovery, atrophy of the musculature of the lower
extremities.   Whether this was due to the immobilization or not, the
writer leaves undecided.

The conservative method of treatment consists in the following:
The injured limb is put into a moulded splint, slightly elevated and an
ice-bag applied to the knee.   The limb is kept at rest, while ice-bags
are applied to prevent an increase of the effusion.   During the first
few days the patient remains quietly in bed and the treatment confined
to simply changing the ice-bags.   This is kept up until the patient be-
gins to complain of their being troublesome, which is usually after
forty-eight hours.   Then they are left off and he is allowed to be a day

with the limb in a moulded splint without a bandage, or with Martin's
bandage loosely applied. On the third, fourth or fifth day massage is
begun, one séance, of 5 to 10 minutes' duration, being practiced
daily. After this Martin's rubber-bandage is applied, care
being taken that it does not compress the limb too much. All at-
tention is turned toward inducing rapid absorption, and one is, indeed,
often astonished to see what an influence a single performance
of massage will have. From the beginning of massage the
effusion generally diminishes perceptibly day by day, the mobility
of the joint increases and keeps pace with the massage. A few days
after beginning to employ massage the patient gets up and hobbles
around with a stick, which he gradually leaves off. During the night
the limb is placed in a moulded splint and wet compresses are applied.
The rubber-bandage being impermeable acts as a portable Russian
vapor bath, and, if well applied, gives an agreeable feeling of support.
The bandage should only be so applied that the edges lie flatly with-
out forming creases or folds, for if it be stretched any the patient will
complain of the bandage being painful, and oedema of the peripheric
portions will follow. By this treatment one often avoids the stiffness
and sensation of tension in the knee-joint, so often seen after puncture
and irrigation, and which requires so long a period of immobilization.
If this, however, be present, one will find an efficacious remedy in
local vapor-baths (40°C.) employed three times weekly.

The conservative method has the great advantage of being free from
any operation, from fever or pains which latter quite frequently follow
puncture (Bondesen); but the greatest advantage of all is, that the pa-
tient can leave the bed much sooner and attend to his business. This
is of eminently practical importance, as after puncture the patient re-
mains for a long time immobilized in bed. This method is also so
simple that it can be carried out by all, both in hospitals as well as
private practice. The writer finally would limit puncture to those ex-
ceptional cases where the effusion remains for a long time unchanged
or diminishes slowly. F. H. PRITCHARD.

RESULTS OF RESECTIONS OF THE KNEE IN ADVANCED LIFE PERFORMED FOR TUBERCULOSIS, AT THE TUEBINGEN CLINIC.[1]

The original material in this paper is based on 100 cases operated in the years 1875 to 1888. Of these cases, 46 were in the first ten years and 54 in the last four, showing the increased confidence generated by improving results. In reality all adult cases are included, the ages ranging from 20 to 60 years; 4 were over 60 years of age, and are considered by Schlüter as in this respect unique. There were 57 males and 43 females, the plus of males being attributable to traumatic influences as a cause. Of specified cases, 52 involved the right knee and 42 the left. The duration of the disease varied from 2 months to nearly 40 years. averaging fully 4 years.

CONDITION OF THE PATIENT ON ADMISSION.

Examination of the diseased joint showed :

Fistulæ in - - - - - - - - - - -	20 Cases.
Tubercular ulcerations in - - - - - - - -	4 "
A flexed position in - - - - - - - - -	40 "
Great painfulness in - - - - - - - - -	22 "
A large accumulation of fluid in - - - - - - -	24 "
Complete ankylosis (however, in only 3 or 4 was the mobility unimpeded) in - - - - - - - - - - -	12 "
Very limited mobility (however, in only 3 or 4 was the mobility unimpeded) in - - - - - - - - - -	15 "
Evident swelling, as a rule, characteristically fusiform, in - - -	97 "
Shortening, 1½, 3, 5, 6 and 18 ctms. respectively, in - - - -	5 "

In all these cases of shortening the trouble began before completion of the individual's growth.

In 11 old cases there was subluxation of the tibia posteriorly, mostly with other conditions such as valgum-position and rotation outward indicating destruction of the joint.

[1] By Dr. O. Schlüter, *Deutsche Zeitschrift. f. Chirurgie*, 1890, bd. 30, hft. 4 and 5

In 5 cases there was fever, and in others evidence as follows of tuberculosis elsewhere: In 7 there were positive signs of phthisis, in 5 of bone disease, in 1 urogenital tuberculosis, in 1 lupus of face, and in 1 tuberculosis of mamma. In addition there were 16 with suspicious catarrh of apex, making a total of 31. Not less than 11 ($35\frac{1}{2}\%$) of these died in the hospital or shortly after their discharge, and 3 were amputated. This makes 45.2% misresults in operated cases presenting demonstrable tuberculosis of other organs.

Operative procedure.—The essential is that the cut shall expose all parts of the joint and thus admit scrupulous removal of all that is diseased. Up to 1878 (7 cases) the subpatellar circular incision was practiced, as also in 9 special cases since. Otherwise Volkmann's cross-cut with sawing through of the patella. The latter is performed as follows: Thorough cleansing. Esmarch's constriction; incision through all the soft parts, joining the tip of the epicondyles with the middle of the patella. Sawing through of patella at bottom of incision. Retraction of lower half of patella with hook. The synovial membrane is prepared off as far as the tibia, the meniscuses being also removed; in like manner removal of the upper synovial. To reach the posterior portion, the knee is bent at an acute angle, the ligg. cruciata and lateralia are divided, and the leg is then pulled downward. If the posterior portion of the joint is still not quite accessible the bone-ends must now be sawed off. This is preferably done within the epiphysial limit, although not as necessarily so as in children. Care must be taken to remove from both condyles equally. The posterior portion of the femoral condyles is then trimmed off with knife or saw obliquely toward the synovial insertion, thus giving better access. It on readjusting the bone surfaces, the leg stands at an angle of 5 to 15°, it is no misfortune, as the gait is then apt to be better than with a fully extended leg. An artificial joining of the joint-ends was not the rule, as König does not find that reunion is thereby hastened nor that the adjustment of the dressing is rendered easier. His statistics, show that the final result is the same whether the ends are nailed or not. After all morbid tissue is removed the cavity is thoroughly washed out, the halves of the patella are joined by catgut stitches, and the skin-wound is closed. Formerly

Lister's dressing was applied, but now more modern styles. After a longer or shorter period, according to the progress of the cure, the antiseptic dressing is replaced by plaster; in this as a rule the first attempts at walking are made, and in 4 to 9 weeks the patient is dismissed some with a supporting apparatus. In 2 the synovial being healthy was spared and in 1 only the upper recessus was extirpated.

Pathological Observations.—In 69 cases there was disease of the bone, 13 times of the femur alone, 27 times of the tibia exclusively, and 21 times of both. The patella was the seat of a focus in 13, and in 5 of these exclusively. In the remaining 31, the process involved essentially the synovial, which was much thickened and covered with tubercular granulations. The cartilaginous covering of the bony surface was with few exceptions more or less destroyed.

Course of Convalescence.—Deducting amputations and deaths there remain 80 cases. Of these, 42 ($52\frac{1}{2}\%$) healed without interruption, whilst the remaining 38 were delayed by suppuration, breaking out afresh of tubercular granulations, or necrosis of skin. Primary unions were few, perhaps 10 in all So far as determinable it took on an average about 2 mos. to the closure of the wound and beginning use of the extremity. Amongst 36 cases those treated by bone-suture averaged 58 days, those without, however, 69 days, showing some advantage in favor of the former. Age makes no particular difference. As in other clinics the average duration of hospital treatment in these cases has been reduced one-half since 1880 as compared with earlier experience.

Results.—Of 12 deaths, 6 were in consequence of the operation (2 from erysipelas, 1 each from carbolic poisoning, sepsis, tetanus and chloroform). Of 11 secondary amputations 3 were fatal Of the remaining 80, 64 were cured; the 16 not cured still presented fistulæ and 5 of these also had a loose knee.

Final results.—Of 70 he has reports up to April, 1889, showing that 44 remained perfectly cured; in 5 the fistulæ existing at their discharge healed later; 20 had died—15 from tuberculosis, 16 within two years of the operation or, to sum up the results to date in the 100 cases, 44 are well, 3 not cured, 11 amputated, 32 dead, 10 unknown. Whilst occasionally no influence or an unfavorable one is exerted on

other tubercular processes, much more frequently the influence seems to be favorable.

For comparisom he tabulates all accessible adult cases from other sources, 187 in number (64% males, 36% females). Cure uninterrupted in 30%. Erysipelas in 12 cases, none fatal. There were 29 amputations with 6 deaths.

For further comparison he presents summary statistics of 274 variously published cases under 20 years of age. Both old and young present the same percentum (63.8) of cures, whilst amputations and deaths are slightly more frequent in the old. His final conclusions are: Resection of the knee-joint for tuberculosis in adults secures to about 64% within half a year a useful leg, and later to a further small proportion also. It is therefore entirely commendable, especially since the duration of treatment has been so much abbreviated, and wherever practicable is decidedly preferable to mutilating amputation. WILLIAM BROWNING.

KOCHER ON THE TREATMENT OF OLD DISLOCATIONS OF THE SHOULDER-JOINT.[1]

This subject has recently been considered in the ANNALS (v. abstract of Knapp's article, October, 1890; p. 303–4). This only makes it more interesting to hear from such an authority in this field as Kocher.

Neglected dislocations of the shoulder are more frequent than of any other joint. This is largely owing to the fact that, according to statistics, this dislocation represents over one-half of all such injuries in the body. It is further due to the partial retention of function, so that the patient, and even physician, may not take the matter seriously. Where the patient's occupation does not require much use of the shoulder, it may even be resumed; but actively the arm is moved with the scapula or shoulder-girdle, the arm can at most be raised to the horizontal, and rotation is greatly limited. Possibly, motion may be much freer. Again, the doctor believes that he has accomplished the reduction when, in fact, he has not; or still holds to the old idea that

[1]Prof. T. Kocher, of Berne, *Deutche Zeitschrit f. Chirg.*, 1890. Bd. 30. Hft. 4 and 5.

reduction is not always possible. By the use of proper methods, how-ever, all fresh cases of dislocation of the shoulder are reducible—a point which he emphasizes.

In old dislocations the diagnosis is much easier than in new, owing to the disappearance of effusion and swelling. The relative painless-ness admits a far more thorough palpation, and a certain degree of atrophy in the shoulder muscles gives better access. In fact, simple inspection usually suffices for diagnosis (as illustrated by plates). Most of the old cases are subcoracoid, some subscapular; the axillary is rare as the causative trauma is severer, the symptoms and disturbances more marked. The deceptive part is the improved mobility at the shoulder, and the nearing of the elbow to the body—the arm may even hang straight down beside the trunk—as compared with fresh cases. This reduced abduction of the arm with essentially unchanged position of the humeral head depends on the stretching of the originally tense por-tions of the capsule and ligaments, especially of the coraco-humeral ligament and its radiations. From this it happens that in luxatio in-veterata much oftener than in fresh dislocations there is a difference in length; particularly in subcoracoid and sub-scapular he has observed a lengthening of 2–3–5 ctm.

In cases with complications, as fracture of the tubercles and border of the socket, the stiffness only increases with time.

The anatomical details are given of a 6 months' old subcoracoid dis-location, the patient having died from other causes; and of 8 cases that had to be subjected to bloody operation. In all but 1 of these 8 cases there was a complication with some form of fracture, usually of the tubercula. In general, his experience shows that it is not so much the attachments in the new position as changes in the old socket that interfere with reduction in these old cases; in fact, there are old dislo-cations in which any manipulative method of reduction, however rational, is absolutely hopeless.

As to the methods of reduction, that by hard pulling is blind, and liable do as much harm as good, by tearing nerves, vessels, etc., as collectively studied by Kortl and by Stimson (ANNALS, 1885). Less destructive is Polaillon's method, subcutaneous section of capsule and

adhesions, yet also liable to do harm. Better yet, is to freely open, and to divide the capsule, not so much to free the humeral head as to make a place in the socket. Complications contraindicate.

The results of resection in these old cases are not sufficiently encouraging for its general adoption. Although Ollier has described (1886) a fine functional success, the patients are, as a rule, scarcely better off than when treated orthopædically without operation. Hence, Kocher limits the indications for resection to cases where no progress or perhaps impairment of mobility, despite gymnastic practice, follows; or where difficulties arise from pressure on vessels or nerves.

In contrast to these questionable procedures he recommends his own rotation—elevation method originally applied (1870) only to fresh cases. By this means he has succeeded in reducing 25 out of 28 older dislocations, 5 of them being over 4 months old. The various published accounts of its application in neglected as well as fresh cases are briefly noted. Although this method was again recommended by Kocher at the London International Congress, 1881, his present description of it may be worth reproducing. "The abducted elbow is slowly but forcibly pressed against the trunk in order to push the humeral head firmly against the anterior border of the socket for the subsequent rotation. To gain a surer hold for rotation it is best to shove the elbow backwards and have it as much as possible approximate the median line behind the body. With the arm flexed to a right angle at the elbow, rotation outwards is now performed, one of the operator's hands grasping the elbow, the other the wrist. This movement also is executed very slowly, opposition being gradually overcome until the forearm is directed straight outwards (laterally). If this manœuvre does not cause the deltoid to be distinctly forced up by the head of the humerus, it is advisable to assist the outward movement of the head by pulling at a compress under the arm. Carafi's proposition to wait a minute after finishing the rotation outward is entirely commendable. This we had often previously done, as the gradual relaxation of tension allows the rotation outward to be somewhat increased. To be approved also is Jersey's proposition to exert downward traction on the

arm during the first two acts. In this way the tension of the upper capsular wall, which we aim to use, is appropriately increased and thereby the rotation about the fulcrum at the anterior border of the socket insured.

Now follows the third act. Whilst the arm is held unchanged in outward rotation, the elbow is pushed forward in the sagittal plane of the body, very slowly but forcibly, as high as possible, when the outward rotation is gradually relaxed, and finally the hand is laid across the breast to the other side, *i e*, the arm is rotated inward.

During this whole time no single, sudden or jerky motion is made. True, however, each of the movements must be completed with a certain force.

For the greater resistance to reposition of old in contrast to fresh dislocations depends on the added resistance of adhesions that to be ruptured demand a certain expenditure of force."

He still bases the method on the fixation of the shoulder in dislocations, by a Y-ligament analogous to that of Bigelow at the hip. of which, at the shoulder, two illustrations are given in explanation.

He emphatically asserts that, it is not irregular adhesions between caput and scapula, which impede reduction, but that the adhesions are predominantly about the old capsular tear between the border of the socket and the anatomical neck.

As misfortunes in his attempts at reducing old cases by this method may be mentioned 3 fractures, 2 simply of the head of the humerus and 1 in the middle of the diaphysis; but the latter was from a necessarily hasty attempt and on an elderly (white-haired) woman.

In 16 of his 33 successes narcosis was not employed. A table of the 28 cases treated by manipulation and of 8 treated by operation closes the article.   WILLIAM BROWNING.

INDEX OF SURGICAL PROGRESS.

GENERAL SURGERY.

I. Experimental Investigation on Transplantation of Mucous Membrane. By E. DJATSCHENKO (Kiev). The first attempt at transplantation of mucous membrane was conducted by Czerny in 1871. From 1873 to 1888 it found practical application, but exclusively in eye troubles. Then Wolfler [v. ANNALS, 1889, January, p. 73-75] published three successful urethral cases, and Schendrikowski, in 1889, one on the cheek. The object of Djatschenko's work was to elucidate the histological process. He experimented on dogs, taking mucous membrane from the mouth and inserting it in place of pieces excised from the eyelid.

The vascular regeneration was in part studied by injecting colored material through the carotid after the pieces had healed down in their new places. The more blood left in the transplanted piece, the more are its vessels thrombosed and the less readily is circulation re-established therein. Complete reunion is established toward the ninth day, no real cicatricial tissue forming. He draws the following practical conclusions:

1. The transplanted piece must lie firmly and intimately against its new base; to this end hæmorrhage must be carefully stopped, the clotted blood carefully removed, and the transplanted piece sufficiently pressed against the wound surface.

2. Before transplantation the piece must be washed off in warm (37-38° C.) .6% salt solution (longer being, up to $1\frac{1}{2}$ hours, in this solution will not act injuriously.

3. The superabundant fat-tissue from the under side of the transplanted piece must be removed by the scissors; still, all the submucous cellular tissue should not be cut away, as otherwise the conditions for

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the re establishment of the blood-circulation in the transplanted piece are less favorable.

4. The piece intended for transplantation, as well as the wound-surface, must not be exposed to the action of strong disinfectants; the transplantation should be conducted as aseptically as possible.

5. The transplanted piece ought, if possible, to cover the whole wound-surface completely, as the uncovered portion forms a scar.

6 The transplanted piece must be protected from dessication.—. Author's abstract of his prize essay, *Centrbl. f. Med. Wissc.*, 1890, Nos. 35 and 36.

II. Plastic Operations. By Prof. JAS. BRANDT (Klausenburg). In the historical introductory remarks he mentions two personal observations of the rapid reunion of almost completely severed noses (bitten off), and one of the reunion of half a terminal finger phalanx that was brought to him in the patient's pocket.

Some experiments on the swim membrane of frogs, the mesentery and ear of rabbits, are briefly given to show that tension or pressure greatly interfere with the nutrition of unsevered parts, and may induce gangrene. The like is often shown by unsuccessful operative efforts. Hence to secure a rapid reunion of tissues one of the first and most important conditions is that after the wound-edges are brought together the tension in the tissue-districts involved shall not be immoderate.

The main interest of the paper rests on two cases, one of vesicovaginal fistula, the other of cicatricial closure of the jaw (anchylostoma).

I. The anterior vaginal and corresponding vesical wall from the neck of the bladder upward over the anterior vaginal arch to the posterior arch, including the portio vaginalis, was absent. Through this defect the vesical mucous membrane, the size of a hen's egg, came down as far as the introitus. The stump of the portio was turned toward the bladder, and not visible, and the posterior cul-de-sac only appeared separated from the prolapsed bladder-membrane by a somewhat ulcerated shallow furrow. The lateral borders of the fistula

space are scarcely $\frac{1}{2}$ ctm thick, thinly cicatricial, and adherent to the pelvic arch.   The only feasable method of closure seemed   to be by turning the upper portion of vagina and mouth of the uterus into the bladder.   Treatment preparatory thereto was carried on from January 14 (1888) to March 27.   This consisted in   downward and lateral stretching of the cervix-stump and posterior vaginal wall (by means of Muzeux's forceps), and of the lateral border of the fistula (with the fingers) two or three times a week.   This course was so painful that narcosis was often necessary.   However, the borders are so far freed that they could be joined across without any tension.

The real operation was divided into two sittings.   In the first the right portion of the defect was covered by uniting transversely the up-per thick border containing the cervical stump with the lower vesical border.   This now sufficed to prevent prolapsus of the bladder, and the patient withdrew for her summer field work.

The second portion of the operation, January 1, 1889, consisted in vertical closure of the remaining defect.   Catgut used for both.   A fine fistulous opening in the line of the first operation was closed by the use of caustics.

II. Student, æt. 19 years.   Shot through the right lower jaw, with loss of various lower and upper teeth, and rupture of right angle of mouth   This left a hard cicatrix through all the soft parts from   the right ala nasi through the angle of the mouth to the inferior border of the lower maxilla, and attached to both upper and lower alveolar pro-cesses. A fistula at the lower portion leads to dead bone.   Only   the tip of the tongue can be put out between the teeth.   Speech   good, except the consonant "t;" eating seriously interfered with.   A pseudar-throsis at the point of injury of the lower jaw, exceedingly   limited, however, in function by the enveloping cicatrix; excision of scar tissue; readjustment by local flaps that he explains by diagrams.   Inasmuch as a raw alveolar surface skins over readily, if only the opposed surface be protected by normal epithelium, he took one flap of mucous mem-brane from the inner alveolar surface, as far   as the lateral border of the tongue, and transferred it for a lining to part of the buccal wall.

Result good; the pseudarthrosis is still limited — *Deut. Zeitschr. f. Chirg.*, 1890, Bd. 30, Hft. 4 and 5.

WILLIAM BROWNING (Brooklyn).

III.   On the Use of Sterilized Sponge in Wounds with Abundant Secretions.   By Dr. ANTONIO RICCI (Stia, Italy).   A lady, while standing at a window, was suddenly enveloped in flames by her clothing igniting from a brazier at her feet.   A large burn of both sides of the body, extending from the lumbar to the popliteal region, resulted.   The writer was called in at the time of the accident, dressed her wounds, but did not, however, see her again until suppuration had well commenced, when he found the patient somewhat emaciated, al ternating nervous excitement and depression with delirium, and a temperature of 40.2° C. (104.5°F.) A profuse diarrhœa also increased the gravity of her condition.   Tonics and stimulants were given to combat the impending adynamia, and a light diet ordered.

The surface of the extensive burn was covered with slices of sponge, sterilized in boiling water and soaked in an antiseptic solution.   This covering was renewed twice daily.   On removing the sponges the surface of the wound was found free from any secretion, and of a beautiful reddish color.   The presence of this dressing produced not the slightest irritation, while, on the contrary, as soon as the sponges were removed, her sufferings were quite severe.   Before renewing the dressings the precaution was always taken to submit them to a prolonged spraying by means of Richardson's apparatus.   After about six days of this treatment the wound commenced to close over, the num ber of sponges was reduced, until finally the process of reparation had so far progressed that a powder of iodoform and quinine could be applied.   Little by little the large wound closed in its margins, the general health of the patient in the meantime improving, until a complete recovery was attained.   The writer also mentions a second case, which he had before treated successfully by this method.— *Lo Sperimentale*, 1890, 9, p. 253.

IV.   Relation of Malaria to Surgical Operations.   By Dr. MORALEZ PEREZ (Barcelona, Spain).   The writer, after an investiga-

tion of the relation of malaria to surgical operations, concludes as follows:

1. One should avoid as much as possible operations in places or districts where malaria prevails.

2. In cases of operation upon individuals residing in malarial districts, or even those who have formerly dwelt in such regions, although they may never have presented malarial symptoms, they should be subjected to a preliminary treatment by quinine, in order to avoid complications.

3. Individuals may be met with in whom there is a latent existence of the germs of malaria. These latter may develop when the strength of the patient has been lowered by hæmorrhage, suppuration or other causes.

4 If one had to decide between a bloody and a bloodless method of operation, the latter should be chosen, for beside avoiding hæmorrhages, a mixed infection is also thus prevented.

5. In cases where operation on account of some suppurative process is necessary, and where malaria has formerly existed, a careful analysis of the urine and an examination of the liver, spleen and kidneys should be made, for the patient may be suffering from diabetes or amyloid degeneration.

6. If hæmorrhage or intermittent pain follow the operation, they may be combatted by the various preparations of quinine.—*El Siglo-Medico*, 1890, p. 58.

V.   On the Neutralization of the Tetanogenic Virus and the Surgical Prophylaxis of Tetanus. By Prof. G Sormant (Padua, Italy). In a preceding article on the same subject the author came to the conclusion that iodoform is one of the most active and specific disinfectants against the tetanogenic virus. In this work he gives the results obtained by experiments with other chemical substances to neutralize this virus. His conclusions are:

1. Camphor and camphorated alcohol have no germicidal action.

2. Chloral shows itself active in the neutralization of the tetanogenic virus.

3. Chloroform and chloral hydrate exercise an attenuating action in a variable degree, retarding more or less the development of the cultures, and also rendering some cultures sterile.

As regards the surgical prophylaxis of tetanus the author, from the observation of two clinical cases, comes to the following conclusions:

1. If tetanus is already established the application of iodoform is no longer efficacious to arrest it.

2. Nevertheless the same remedy will completely neutralize the virus in the wound.

The author has also made experiments as to whether it was possible to arrest the development of tetanus during the period of incubation by the use of iodoform, and has, in regard to this, arrived at the following conclusions:

1. In the animals, in which local prophylaxis was carried out by the use of iodoform early after infection had taken place, and where the tetanic manifestations had not yet developed, the convulsive period could be prevented.

2. If the first symptoms of the disease had already developed, there was the less chance of success the later one acted. The author, finally, mentions that in the city hospital of Padua, among more than 500 patients, suffering from some kind of wounds, and treated with iodoform, there occurred no case of tetanus. After having met with a case of death from iodoform poisoning, he tried in a number of cases of wounds sublimate and salycilic acid, but among these latter had two deaths.—*Riforma Medica; Gazzetta degli Ospitali*, August, 1890.

ALBERT PICK (Boston).

HEAD AND NECK.

I.   Excision of the Gasserian Ganglion.   By WILLIAM ROSE, F.R.C.S. (London).   At the Medical Society of London, October 27, 1890, Mr. Rose related the case of a lady æt. 60 years, who had suffered for years from the most acute neuralgia, first affecting the inferior division of the fifth nerve.   He first stretched the inferior dental nerve and divided its mental branches, which gave temporary relief.   The trouble recurred however, and in March, 1889, he trephined the lower jaw

and cut away a piece of the nerve trunk. This also produced temporary relief, but a year later the old pain returned, involving in addition the right side of the tongue, indicating the extension of the trouble to the lingual nerve. He then cut down upon the inferior dental and lingual nerves in the pterygoid region, through an incision parallel to the zygoma. The operation was not very satisfactory, however, owing to the abundant hæmorrhage, but he felt convinced that he had divided and partially excised both nerves in this region. The result of the operation was to produce numbness in the right side of the tongue and integument of the lower part of the jaw. Unfortunately the pain which had occasionally manifested itself in the upper jaw and cheek became greatly intensified. It implicated the alveolar border of the right upper maxilla and extended to the vertex of the head, showing that the superior maxillary division of the fifth nerve was involved. In accordance with the suggestion of Dr. Ferrier, he then determined to proceed to the removal of the Gasserian ganglion. He decided to remove the upper maxilla at the same time (1) because he believed that there was extensive disease of the nerves in the maxillary bone itself; (2) since the manipulations at the base of the skull would be greatly facilitated by the removal of the upper jaw, and (3) in deference to the express wish of the patient that, whatever he did, he should remove what she called the "focus" of her suffering. Accordingly on April 2, he proceeded to remove the upper maxilla in the usual way, and then, with a skull in front of him to serve as a guide, he inserted the pin of a half inch trephine into the foramen ovale and removed a ring of bone. He then caught sight of the Gasserian ganglion on the petrous bone, passed an aneurism needle gently beneath it without injuring the dura. The patient suffered somewhat from shock, but on the following day her condition was satisfactory. She, however, complained of heat and pain at the back of the right eye-ball, which was very congested; this increased and resulted in panophthalmitis, necessitating the removal of the eye. Her progress in all other respects was very satisfactory. The neuralgia entirely ceased and had not since returned. He thought that in future, when it was necessary to remove the ganglion, this might perhaps be accomplished without removing the jaw. He ex-

tremely regreted the loss of the eye, and was disposed to regard it as ac-
cidental and not as a necessary result of the operation.—*British
Medical Journal*, November 1, 1890.

<div align="right">JAMES E. PILCHER (U. S. Army.)</div>

II.   Trephining in a Case of Actinomycosis of the Brain.
By OTTO E. KELLER, M.D.   The patient, a married woman, æt. 40
years, gives a history of suffering, two years previous to the develop-
ment of the cerebral symptoms, from two actinomycotic abscesses over
the left chest.   When Keller saw her she complained of gradually increas-
ing weakness of the left arm.   At that time a diagnosis of an actino-
mycotic lesion of the motor regions was made, operation advised but
declined.   She then developed convulsions of the left arm paresis de-
veloped and soon involved the left half of the body.   Headache, vom-
iting and complete loss of consciousness followed.   The friends would
not consent to operation until the patient was apparently moribund.
Then without an anæsthetic trephining was done over the right ascend-
ing frontal convolution.   The dura and brain substance were incised
and two ounces of thin, green pus, containing great quantities of
actinomycosis grains, was evacutated.   The patient immediately
(while on the operating table) awoke from the deep coma and called
for a drink of water.   The wound did well and patient was able to get
about again.   A year later grave symptoms again appeared, the brain
was again incised and a considerable quantity of pus evacuated.   This
did not materially improve the patient's condition and she died in a
few days.   Post-mortem showed the middle third of the right frontal
and parietal convolutions occupied by a large mass of newly formed
tissue and deeply buried in the white substance, an unopened encap-
sulated abscess of the size of a nutmeg.—*British Medical Journal*,
March 29, 1890.

<div align="right">H. BEECKMAN DELATOUR (Brooklyn).</div>

<div align="center">GENITO-URINARY ORGANS.</div>

I.   Operations on the Enlarged Prostate.   By DR. W. T.
BELFIELD (Chicago).   The author claims that accumulated clinical
observation proves:

1.   That in most cases the failure to evacuate the bladder is due in no wise to degeneration of the vesical muscles, but solely to the mechanical obstruction offered by prostatic growths; since the removal of such obstacles has been followed in over two thirds of the cases previously dependent upon the catheter by restoration of the vesical functions.

2.   That the enlargement of the prostate commonly called "senile" hypertropy is not limited to advanced life.

3.   That the prostatic obstruction is usually of such form as to permit excision, for out of seventy-seven cases in which suprapubic section was done, in sixty-two such obstacles were found and removed.

The author admits, however, that in many prostatics of advanced age, a degeneration of the vesical walls co-exists, so that the contractility of the bladder is much impaired. Differentiation between obstructive and degenerative factors in a given case ought to be made before operation, though it cannot always be accurate. Evidences of general tendency to sclerosis, as shown by rigid arteries, polyuria, often hæmaturia, extremely hard prostate, feeble flow of urine through catheter, and complete evacuation of the bladder only by pressure upon the hypogastrium, are the symptoms that point to degeneration, and render operative interference unpromising.

Any operation should secure these results: restoration of a low level urethra by removal of prostatic obstacles; temporary drainage of the bladder, and stretching of the prostatic urethra. Since prostatic obstructions present great diversity in size, shape and location, digital contact is the first essential of every accurate radical procedure. A perineal incision will certainly fail in a large percentage of cases to afford the required access to the intravesical obstacle. Suprapubic cystotomy secures minute exploration of the intravesical projections, and thorough drainage of the bladder, yet several instances are recorded in which the removal of salient intravesical growths by this route failed to remedy the prostatic obstruction, owing to the presence of urethral prostatic growths that were not reached. The exploration of the urethral portion of the prostate is quite as important as that o its vesical portion. Especially frequent is a pronounced thickening of

the suburethral prostate whereby the urethra is elongated and the vesical orifice displaced upward. The prostatic urethra should be stretched and explored by the finger, and the discovery of a hard mass or an unduly rigid ring should be the signal for perineal urethrotomy, incision or excision of the resisting tissue and thorough stretching. The author thinks it probable that the combined operation by both suprapubic and perineal incisions will become the rule rather than the exception, since it affords an access to the entire prostate which may convert an utter failure into a complete success.

Thorough enucleation of all circumscribed masses within as well as above the general prostatic surface should be done. Such tumors can be enucleated after incision of the mucous membrane with surprising facility.

The abstract utility of prostatectomy has hitherto been clinically restricted by the fact that so many patients requiring the operation are too feeble to endure it when they reach the surgeon. The hazard of the operation is chiefly due to pre-existing disease of the urinary tract, together with enfeeblement of vitality from age and protracted suffering. In very feeble patients perineal prostatectomy alone should be done, since it may be so quickly completed, involves less peril from the anæsthetic, affords temporary relief in all cases, and a radical cure in a fair minority.

Operation should be resorted to earlier in the course of the disease, and not, as heretofore, deferred until the last stage.

Opportunity is still lacking —because the operation is so recent—to determine decisively whether the restoration of voluntary urination is permanently assured by prostatectomy; further experience must show whether new tumors may not frequently develop from the unexcised prostate, causing a recurrence of the original morbid condition.— *Am Jour. Med. Sc.*, November, 1890.

II. Prostatomy and Prostatectomy and the Indications for Their Performance. By Dr. EDMOND VIGNARD (Paris). The author, in a very exhaustive and careful manner, undertakes the task of critically reviewing the present status of operative attacks upon the

prostate, for senile hypertrophy. He avails himself of the latest French, English, German and American literature upon the subject, and tabulates the statistics, as well as giving a faithful resumé of the whole matter at the end of the work. These operations are not, in the judgment of the author, as a rule, of sufficient value to warrant their performance.

In this respect he agrees with Socin, of Basle, Sir Henry Thompson and Guyon, whose pupil he is. His notice of the history of the operation is in many respects interesting, and, in a sense, valuable. Forty-one cases are gathered from the literature upon the subject, 89 of these being from recent times, while only 2 of the older operations are noticed, and these by Mercier. The cases are divided into the following four groups:

1. Supra-pubic prostatectomy.
2. Perineal prostatectomy.
3. Perineal prostatomy.
4. Urethral prostatectomy.

Of these there were 22 cases of prostatectomy by the supra-pubic route; 4 cases of prostatectomy by the perineal wound; 10 cases of simple incision (prostatomy) through a perineal wound, and 5 cases of urethral prostatectomy. The latter, however, received no further notice than to be summarily disposed as above, with the expressed opinion that this operation is one not at all to be justified in the performance. The technique of the other operations are discussed, and the conclusions arrived at that no difficulty should be experienced in their performance. The scissors, thermo-cautery or galvano-cautery may be employed at the pleasure of the operator. Harrison's suggestions of keeping a drain in the wound with its extremity resting well within the neck of the bladder in perineal cases is mentioned and highly commended. The complication of hæmorrhage, so often feared is not an important one; the loss of blood may be considerable, but is never to be feared as likely to produce a fatal result. Five cases, all supra-pubic, died shortly after the operation, the death being due in one instance to pleuritis, in another to pneumonia; in 2 cases chronic nephritis is responsible for the fatal issue; while only in

a single case was observed the occurrence of a fatal infection, this following on the fourth day following the operation. The perineal and urethral operations have thus far proven to be comparatively free from danger, so far as these statistics cover the ground.

In order to appreciate the results of these operations from the author's standpoint, the indications which led to their performance are examined into. The 5 cases of Gouley's method of internal (urethral) prostatomy being rejected as entirely unworthy of consideration as a formal surgical procedure, the remaining cases are studied with this view. In only 18 of these latter was there existing at the time of the operation complete chronic or almost complete retention. All the other operations were performed for acute retention or cystitis. Out of these 18 cases 2 died, and in 6 other cases the operation failed to achieve its object, namely, the restoration of voluntary urination. The operation was successful in achieving the latter 6 times, the cures remaining permanent. The remaining cases have been under observation for too short a period of time to be properly studied. Three cases among those which proved to be permanently successful were treated by Harrison's method of permanent perineal drainage. Three cases are reported in which the question of the ability to perform catheterization is studied; in 2 of these permanent improvement took place in this respect, while the other showed only temporary improvement. Useful and completely successful though these operations upon the prostate may be, yet the latter result is only rarely reached. Incomplete or partially successful operations, following which a previously existing cystitis may be improved, yet the necessity for catheterization which continues cannot be construed into offering arguments in favor of the operation, for the reason that quite as favorable results are reached by simple incision and drainage, without interference with the prostatic enlargement.

The great majority of failures of the operative attacks upon the prostate announce themselves as such in the very beginning. Absolutely no improvement is manifest in the symptoms which can be legitimately credited to the operation itself. In another class of cases there is an apparent and indeed a positive improvement, and for a

time this continues. But later on there is a recurrence of the original conditions, and relapse occurs. Reliable observations have shown that this is due, without doubt, to a re-growth of the p.ostatic barrier at the vesical neck. In cases in which there is found to be absolutely no improvement, it will be found that the existing form of hypertro-phic enlargement was not of the variety in which the obstruction was removable by operative measures, such, for instance, as the higher grades of hypertrophy of a horse-shoe shape, or with larger lateral lobes, but no well marked point of obstruction or valvular middle lobe. Another reason for complete and immediate failure is the existence of paralysis of the bladder, or inability of the latter viscus to contract upon its contents. Indeed the success of the procedure will depend greatly upon the abil.ty of the operator to determine beforehand the particular form ot hypertrophy which is to be dealt with; the failures of the operation will be in direct proportion to the care exercised before-hand in this regard. It may be stated that non contractibility of the bladder is of itself a contra-indication, to say nothing of the want of existence of a definite bar to the exit of the urine, or entrance of the catheter.

But these conditions are only exceptionally fulfilled. It will be but rarely demonstrated beforehand exactly what condition of the prostate is really at hand, and still more rarely will it be found that the particu-lar indications pointing to the probability of affording relief are pres-ent. In 24 museum preparations examined with the view of deter-mining the question of the frequency ot the occurrence of the opera-tive forms of the affection, it was found that only a very small propor-tion offered the conditions usually considered favorable for interfer-ence. As to the contractility of the bladder, it may be stated that, in this class of patients, atheroma of the arteries exists, and it has been shown that atheroma and cystic paralysis are usually combined.

Having selected the cases with great care, and subject to the re-strictions above indicated, the next care ot the surgeon will be that of the selection of a proper route to the point of obstruction, and the selection of means by which the latter may be removed. Supra-pubic section will probably be the procedure most generally tollowed for this.

purpose, and should the anatomical conditions present prove to be such as to encourage the operator to a further step, either the thermo cautery or galvano-cautery, or the curved scissors, inasmuch as hæmorrhage is not to be greatly feared, will afford ready means of accomplishing the removal of the desired portion. Should prostatomy only be indicated, perineal incision and drainage, this latter being accomplished by the wearing of a drainage tube for a considerable time, as recommended by Harrison, of Liverpool, is to be followed. Not only does this method of after-treatment give decided relief to the cystitis, and its train of distressing symptoms, but it likewise tends to prevent a recurrence of the obstruction, which otherwise would naturally be expected.

Meinhard Schmidt, in this connection, expresses the hope, which will be echoed by all surgeons to whom this class of cases must always possess great interest, that these operative procedures upon the prostate may not be abandoned until further trials have been made. It may be that time and patience will yet evolve a means of bringing relief to those who, in those years of their life to which they have looked forward with anticipations of rest and comfort, are doomed to suffer, with an increasing certainty of incurability as the case now seems to stand, from prostatic enlargement.—*Centbl. f. Chirg.*, 1890, No. 32.

III. **Lateral Prostatectomy.** By Prof. Dittel. The many disappointments experienced by surgeons in operations upon the enlarged prostate, both in older as well as in recent times, led Dittel to inquire more carefully into the subject of the anatomical conditions present in senile hypertrophy of this structure. The entire attention of surgeons has been directed to the middle lobe as the cause of the obstruction to the passage of urine, and the entrance of a catheter. That this should be the case is clearly set forth, and the reasons therefor given by the author. They consist in the statement, supported by experiments upon the cadaver, that although the most severe cases are those in which the middle lobe is involved, still, accompanying this, is to be found a high grade of hypertrophy of the lateral lobes and to this latter is to be attributed the real reason for the retention and its con-

sequences. This is shown by clinical experience, by observation during the median incision, and, as before stated. by Dittel's experiments upon the cadaver.

If, therefore, the surgeon seriously contemplates operative procedure in this class of cases, he will do well to bear in mind these studies by Dittel regarding the role played by the lateral lobes in obstructive hypertrophy of the prostate. This surgeon made the following experiments upon the dead subject. A cadaver was selected with the genito-urinary tract in a normal condition. During suspension the bladder was filled with fluid, and it was observed that this latter flowed away, completely emptying the bladder in a short time. In a cadaver selected on account of the existence of lateral prostatic hypertrophy, the fluid thrown into the bladder flowed away imperfectly, and after twenty-four hours of continual suspension, a considerable amount of residual fluid remained. In cases of bilateral hypertrophy of the prostate, and in which resection of the lateral lobes had been made, the entire fluid contents of the bladder flowed promptly away under the same conditions otherwise. Excision of a wedge-shaped portion of the middle lobe gave no result.

The method of carrying out this procedure upon the living subject as recommended by Dittel based upon his experiments upon the cadaver, is as follows:

The patient is laid either in the abdominal position, with the lower extremities depending from the edge of the table, or in the right lateral position with the thighs drawn up. The bladder having been emptied and washed by means of a rather heavy gum-elastic catheter, the latter is fastened in situ. The rectum is tamponed in order to be able to identify it during the subsequent steps of the operation, as well as to avoid injury to the same. The incision is made from the point of the coccyx in the direction of the middle of the external sphincter ani, coming around the latter to the raphe of the perineum. By means of this incision the ischio rectal space is entered, and the tamponed rectum is grasped and loosened by blunt dissection from its attachment to the right lobe of the prostate. The intestinal tube is then freed from its attachment to the left lobe of the prostate in the same

manner. All vessels are carefully ligatured before proceeding to the resection, and the ischio-rectal space rendered antiseptic. The lateral lobes are then resected by removing from each a wedge-shaped portion corresponding to the extent of the hypertrophy in the same manner as enucleation of a tumor is performed.

The operation may be indicated in the first stage of cases of prostatic hypertrophy, when the urine is still in a healthy condition, and when pain and residual urine are not prominent, and in the second stage, when the patient may be convinced of the advantages of a radical cure over the palliative measures usually employed. —*Wien. Med. Wochenschrift*, 1890, Nos. 18 and 19.

G. R. FOWLER (Brooklyn).

TUMORS.

I. **A Case of Hygroma Proliferans Endothelialis.** By Prof. B. MORISANI (Naples). The neoplasms which develop progressively and have their origin in the mucous bursæ are very rare. The number of cases reported up till now amounts to 7, and belong to Holscher, Simon, Schuh, Dollinger, Mikulicz, who reported one each, and two cases were described by Ranke. The case of the author, being the eighth, is of special interest on account of its peculiar nature.

The tumor was observed in a girl, æt. 15. It arose at the internal margin of the right foot, was pyramidal in form and solidly implanted upon the internal tuberosity of the scaphoid bone. It was of a duro-elastic consistency, less so at its apex, where a small place of softening was noticed, which, as well as the soft œdematous base, presented fluctuation. Movements of the foot did not cause pain, but pressure with the finger upon the projecting part of the tumor excited pain. The patient has noticed since a year an increase in the size of the tumor, and it now has the size of a hazel nut. Her general condition is rather low; her mother died of some chronic disease of the thoracic viscera. The author's diagnosis was tuberculosis, and he proceeded to operate on this tuberculous focus. During the operation, however, he became aware that he had not to deal with a focus of tuberculosis. Morisani made a careful macroscopic and microscopic ex-

amination of the removed growth, and came to the conclusion that the tumor was composed of a cavity and its contents, reminding one very much of a very dense, cystic exudate, the wall being composed of two layers, the internal of which presented eminently the characteristics of a neoplasm. The author believes that this tumor took the place of the bursa mucosa, which, as is known, is situated at the insertion of the tendon of the tibialis posticus. He also excludes with certainty the simple inflammatory and hyperplastic, as well as the neoplastic, tuberculous nature of this tumor. From its structure he also excludes the possibility of its being of a sarcomatous nature. In fact, this tumor presented all the characteristics of those described by Virchow under the name of *hygroma proliferans*. The author would also here in this case apply this name, but in order to indicate by his definition the peculiarity in the structure of this growth, which differentiates it from the other forms of *hygroma proliferans*, would add the word *endothelialis*, thus calling it *hygroma proliferans endothelialis*. The article of Prof. Morisani contains a lithographic plate, which presents drawings of some interesting microscopic specimens of the growth described above. It also shows the foot with the seat of the growth.—*Progresso medico; Rivista Clinica dell Universita di Napoli*, No. 6, 1890.

A. PICK (Boston.)

BONES, JOINTS, ORTHOPÆDIC.

I.   **Successful Operation for Spina Bifida.**   By Dr. JULIO- CINTO (Florence, Italy).   The writer, after a short consideration of the various means used in the treatment of spina bifida, describes a case which he successfully treated by operation.

G. O., a male child, one month of age, well nourished and in good general condition, entered the hospital June 3, 1890, with a large lumbar spina bifida. The tumor was of the size of one's fist, had a broad base, and a longitudinal diameter of 8 cm., while transversely it measured 12 cm. The tumor had all the characteristics of a spinal hydromeningocele; the skin covering it was normal, thin and tense. There was a defect in the spinal column of about 3 cm. The tumor

was congenital, but for the last month it had rapidly increased in size. The lower extremities were unaffected; the urine and fæces were passed involuntarily. Inflammation of its (the tumor's) integuments had already commenced, and extirpation of the sac was decided upon. A semielliptic incision was made on each side of the tumor, and an attempt made to dissect the sac down to the fissure in the spinal column, but it (the sac) broke, and the contents escaped. The pedicle being quite broad was then ligated with four sutures passed through its substance, and the tumor removed. The skin was then sutured and an aseptic dressing applied. The next day the child's general condition was good, and, with the exception of a slight disturbance on the third day following the operation, everything progressed well: the child recovered its vivacity; its appetite improved, and it slept well. The wound healed without any inflammation, but its course was complicated by a failure of the middle portion of the wound to heal, and through which the cerebro-spinal fluid dribbled. This and the continual defiling of the dressings with urine and fæces, rendered a daily change of the dressings necessary. This dribbling, however, soon ceased, and the unhealed spot soon dwindled down to a small point and healed. No inflammation of the spinal meninges occurred, in spite of the continual soiling of the dressings. The writer ascribes the failure of the wound to heal entirely to his use of the multiple ligature, as one of the strands apparently tore out of the tender integuments. He also calls attention to the fact that evacuation produced none of the disastrous results reported in other cases — *Lo Sperimentale*, vii, 1890.

ALBERT PICK (Boston).

II.   On Elbow-Joint Dislocations Complicated with Rupture of the Brachial Artery and the Resulting Ischæmic Muscular Alterations. By DR. E. MELITOR (Carlsruh, Heidelberg). The case here related was that of a farmer, æt. 22, who, in attempting to mount a moving wagon, fell backward on the flexed left elbow and dislocated the radius and ulna backward. Before any attempts at reduction it was noted that the hand was pale and both radial and ulnar

pulse absent. When brought to the hospital next day the whole arm was tensely swollen, the hand motionless and especially on the radial side partially anæsthetic.

Under moist warm dressings the swelling steadily abated for five days. Then, two hours after placing the hand in an elevated position, it suddenly became ischæmic. An incision along the inner side or the joint, parallel to the median nerve, permitted the removal of coagula and showed that the dislocation had been reduced, but did not disclose the proximal end of the artery. As, however, the circulation was not re-established, and the extremity clearly could not be preserved, it was amputated 6 centimeters above the elbow, 9 days after the accident. It was found that the biceps had been torn off 4 centimeters above its insertion, and the brachialis anticus $3\frac{1}{2}$ centimeters above. As the anterior wall of the joint-capsule was quite torn across and the internal and external ligaments almost completely severed, he holds that it was rather a dislocation forward of the humerus than backward of the ulna and radius, and quotes two other cases of such dislocation. Of further cases of dislocation of the elbow with rupture of a large artery he has collected 11; these were mostly of the brachial, though in 2 cases of the ulnar. Only 1 of the 11 was, like this, subcutaneous; all the others were compound. In this previous subcutaneous case, amputation had to be performed on the sixth day. In 8 of the 10 compound cases the arm was preserved, though in several more or less disabled. In fact, usually the small collaterals are injured as well as the main vessel.

The microscopical examination showed, in the most affected muscles, principally, an œdematous soaking and a vanishing of the muscle-nuclei. Various considerations lead him to the conclusion that "In subcutaneous injury of larger arterial trunks, especially where it has led to a considerable extravasation of blood, immediate free incision under extreme antiseptic precautions, with thorough removal of coagula and double ligation, is indicated and preferable to the expectant plan."— *Bruns' Beitrage z. klin. Chirurgie*, 1889, bd. v, hft. ii.

WILLIAM BROWNING (Brooklyn).

III. Case of Incised Wound of the Knee-Joint with Transverse Division of the Patella. By PAUL SWAIN, F.R.C.S.

A girl æt. 5, after a fall upon some sharp shingles, was found to have sustained a clean incised transverse wound over the right knee-joint extending from the outer condyle over the front of the joint about four inches, opening the joint freely and exposing the right condyle; and, in addition the patella was completely divided transversely, as if it had been cut through with a knife. Under methylene anæsthesia, the wound was thoroughly washed out with carbolic solution; the patella was then drilled in three places and the fragments securely wired together; a few vessels were ligatured with fine chromic gut and the edges of the wound accurately coaptated with carbolized silk, after which a drainage tube was inserted and the limb dressed with carbolic gauze and placed on a back splint. The child suffered no pain after the operation, and passed on to complete recovery with perfect use of the limb in a little more than two months.—*British Medical Journal*, November 15, 1890.

JAMES E. PILCHER (U. S. Army).

CHEST AND ABDOMEN.

I. **On the Surgical Treatment of Intraperitoneal Tuberculosis.** By PROF. CZERNY (Heidelberg). The favorable view of the curability of tubercular peritonitis, as presented by the cases of Kümmell (*v.* ANNALS, 1887. December, p. 504), and others, has already been criticised by Spaeth (*v.* ANNALS, 1889, August), and is here again shown to be over-sanguine.

Tubercular inflammations of serous membranes may subside, but the process is so often dependent on adjacent foci (glands, urogenital tract, etc.), that other sequelæ are bound to follow. Pleurisy preceding tubercular bone and joint disease is a daily experience, if attention is given to this point in taking the history. Where the nucleus of infection is limited and removable, then permanent cure may be hoped for. His cases, briefly stated, are as follows:

1. Ovariotomy in the presence of miliary tuberculosis of the peritoneum (1878). Cure. Perfectly well 11 years later.

2. In operating for an inguinal hernia (man, æt. 38 years) that had

become painful, a piece of the attached peritoneum was removed and found to bestudded with miliary tubercles. The patient had scrofulous cicatrices, and his parents had died of consumption. Uninterrupted cure. Still well 4 months later.

3. Maid, æt. 32 years. Removal of a pedicled myoma. The covering peritoneum was covered with miliary nodules. Good recovery from the operation. Death from chronic peritonitis 6 months later.

4. Tubercular alterations in the cæcum, at first thought to be a floating kidney. Suturing of the kidney to its proper place, with apparent improvement. Then relapse, demanding resection of the tubercular portion of intestine (cæcum and adjacent gut). Cure, verified 3 years later.

5. Tubercular tumor of cæcum, at first thought to be cancer. Resection of intestine. Injury of ureter. Extirpation of kidney. Death from peritonitis 6 days later.

6. Intestinal fistulæ starting from a perityphlitic abscess. Suspicion of tuberculosis. Double resection of gut and direct suture. At first cure; later, the fistulæ broke out again.

7. Tubercular ulcerations in the cæcum, cured by resection of the intestine. Man, æt. 40 years. Was well 14 months later.

8. Peritonitis tuberculosa with fæcal fistulæ. Amyloid degeneration of abdominal organs. Attempt at curing the fistulæ by resection of intestine. Death in 10 hours.

9. Broken-down tubercular lymphoma of the mesentery. Incision, partial extirpation, drainage. Death from septic peritonitis.

10. Cystic softened (tubercular?) lymph-gland of the mesentery. Extirpation. Cure.

11. Cheesy endometritis. Salpingitis. Peritonitis tuberculosa. Incision; resection of the tube. Death from miliary tuberculosis.

12. Exudative peritonitis with miliary tuberculosis. Incision. Death 3 months later.

13. Same, except exitus in 2 months.

14. Adhesive tubercular peritonitis. Partial extirpation of the tubercle nodules. Secondary fæcal fistula. Death 3 weeks later.

15. Adhesive tubercular peritonitis. Tedious extirpation of tuber-

cular deposits and tubes. Secondary formation of fistula. Death 4 months later.

16. Same. Death from phthisis 3 months later.

In only 2 of these 6 cases of tubercular peritonitis was the diagnosis correctly made before the operation. He concludes that for operative purposes we should separate that form of peritoneal tuberculosis where there is fluid effusion and miliary nodules, from the drier adhesive peritonitis, characterized by firm tumor like lumps, plats and strands. It is the first form that has yielded such results from laparotomy, whilst, as three of his cases show, the latter form is not surgically encouraging. One of his cases indicates that the form with effusion may by resorption and thickening, pass into the dry form.

The surgery of intestinal and lymph-gland tuberculosis is very difficult, and as yet has been practiced but to a limited extent; still from his cases he urges further attempts in this direction.—*Bruns' Beitrage f. klin. Chirg* , 1890, bd. vi, heft 1.

WM. BROWNING (Brooklyn).

II. On the Treatment of Peritonitis by Abdominal Section. By DR. MIKHAIL R. OSMOLOVSKY (St. Petersburg, Russia). The author has collected 231 cases of peritonitis treated by abdominal sec tion. Of the number, 79 were taken from German literature, 40 from British, 29 French, 22 American (U. S.), 14 Polish, 12 Russian, 8 Italian, etc. Of the total, 75 died, 154 (67.2%) recovered, while in two cases the issue remained unknown. The writer divides his cases into 8 groups.

I. *Traumatic peritonitis* (developing after surgical operations or accidental traumata).—Nineteen cases are tabulated, of which 6 died, and 13 (68.5%) recovered. The time of operation varied from 2 hours to 4½ months after injury. (The group consists of cases published by Bardeleben, Barwell, Bouilly, W. Bull (2), Chavasse, Escher, Talaguier, Keetley, Kelly, Koeberlé, Koenig, Lannelongue, G. Owen, G. V. Pavloff, Poncet, Robertson, Steer and Vacher. Once Dr. Osmolovsky has thought proper to include into the series W. Bull's and Talagnier's cases of gunshot wound, treated by laparotomy in 2 hours

after the accident (that is, before the development of any appreciable signs of peritonitis), he ought to have collected generally all published cases of the operation for traumatism. We recommend him to study Prof. T. S. K. Morton's important paper on "Abdominal Section for Traumatism" (*vide* the *Jour. of the Am. Med. Ass'n*, Jan. 4, 1890; and ANNALS OF SURGERY, April, 1890, p. 271), based on as many as 234 cases.—*Reporter.*

II. *Peritonitis due to ulcerative perforation of abdominal viscera* (appendix, intestines, stomach, bladder).—Forty three cases are recorded, of them 33 ending in death, 10 (23 2%) in recovery. Of the 10, in 8 a "complete cure," and in 2 an "improvement" was obtained.

III. *Peritonitis due to incarcerated hernia and intestinal obstruction.*—Twenty-seven cases are given, with 13 deaths and 14 (51.8%) "complete" recoveries.

IV. *Peritonitis due to bursting of intra-abdominal abscesses or tumors* (ovarian, etc.).—Thirteen cases, with 3 deaths and 10 (77%) recoveries; of the latter 9 being "complete," 1 "amelioration."

V. *Puerperal peritonitis.*—Fourteen cases are recorded, with 7 deaths and 7 (50%) "complete" recoveries.

VI. *Idiopathic peritonitis and that of an obscure causation.*—Twenty-four cases were found, with 5 deaths and 19 (79.1%) recoveries (17 "cured," 2 "improvements").

VII. *Iocalized peritonitis.*—The group includes 14 cases with 1 death and 13 (92.8%) "cured."

VIII. *Tubercular peritonitis.*—Of 77 cases of this description, 7 ended in death, 68 (90 6%) in recovery (46 "cures," 22 "improvements"); in 2 cases the ultimate issue was not stated.

The author's main general conclusions may be summed up somewhat as follows:

1. Speaking generally, abdominal section constitutes the only reliable means for curing peritonitis of any description

2. Under a strict application of all antiseptic precautions, the operation is altogether safe.

3. The frequent relatively high percentage of deaths in cases of peritonitis treated by laparotomy must be attributed mainly to the fact that the operation is usually resorted to only too late.

4. It may be firmly hoped that a routinary early performance of laparotomy will raise the percentage of recoveries very considerably.

5. Of all varieties of the disease, perforative peritonitis (the author's 2nd in category) has up to the present given the lowest percentage of recoveries. Of all the forms, exactly this one requires the quickest surgical interference (immediately after the appearance of pain and other suspicious symptoms). Meanwhile, of all the cases recorded, only in Hirschberg's, the operation was made about 24 hours after the onset of the symptoms; in all others, laparotomy was resorted to as late as 3, 4 and even 10 days after the perforation had occurred. Another cause of a high mortality is that the perforation frequently escapes detection, and thus remains gaping. Collapse does not contra-indicate laparotomy. Escher, Wylie and Hall succeeded in saving their patients by having operated in spite of the presence of the symptom.

6. In tubercular peritonitis, abdominal section undoubtedly manifests a beneficial influence on the course of the disease. The explanation of the fact, however, remains yet to be found.

7 All cases of penetrating wounds of the abdomen should be treated by a possibly early laparotomy. The same may be said in regard to any traumatic peritonitis including that developing consecutively to surgical operation. (The author points to two cases reported by Koberle and Pavloff. In the former, peritonitis set in after ovariotomy and was quickly cured by abdominal section performed on the third day of the disease. In Pavloff's case, the peritoneal inflammation developed after tying the internal iliac artery, the patient's life being saved by laparotomy on the fourth day of the symptoms).

8. Collapse should be regarded as an absolute contra-indication only in cases of tubercular peritonitis. In all other varieties of the disease, it does not contra-indicate the operation, though its presence considerably lessens chances of recovery.

9. In cases of a general peritonitis, the abdominal incision must be free, in order to secure thorough examination and cleansing of the peritoneal cavity. In cases of a localized peritonitis, the incision should be short.—*St. Petersburg Inaugural Dissertation*, 1890. No. 61, p. 128.

III. Excision of Fibromyoma Lipomatodes Sarcomatodes From the Liver.

By PROF. NIKOLAI V. SKLIFOSOVSKY (Moscow, Russia). The author details the following singular case: A generally healthy, well-made and nourished Hebrew married woman, æt. 24 years, was admitted to his clinic on account of a rapidly growing abdominal tumor which had been first noticed by the patient 7 months previously (a week after her only parturition) when it had been not larger than a male fist. On examination, her abdomen was found considerably enlarged and bulging out forward, the middle of the right side being most prominent. Palpation revealed the presence of a dense, partially knobbed tumor of the size of an adult man's head which was but slightly displaced downwards on breathing, but could be easily shifted upwards (into the epigastrium) and moved from side to side. The patient complained of sensation of weight in the right hypochondrium, cardiac palpitation, and sleeplessness, constipation and engorgement of the hæmorrhoidal veins being also present. The diagnosis was rather doubtful. The author thought most probable that he had to deal with a tumor connected with the major omentum or mesentery, but not with the liver, since the percussion always elicited a tympanic tone between the liver and the new growth. An exploratory laparotomy being decided upon, the abdomen was opened with a median incision, 15 ctm. long, running between the navel and pubes. It proved necessary, however, to enlarge the wound up to the ensiform process, after which it became evident that the tumor was growing out from the quadrate lobe of the liver, just to the right from the round hepatic ligament. The new growth constituted a kind of prolongation of the said lobule, being connected with the latter by means of an isthmus measuring 2½ fingers' breadth in width and containing blood vessels of the size of a crow's quill. Having tied the isthmus with an elastic ligature and fixed the liver above to the abdominal wall by means of a stout needle, the author amputated the tumor and stitched the stump into the abdominal wound, after which he closed the latter with suturing and applied a compressing antiseptic dressing. For four days the patient was suffering from considerable prostration with eructations, nausea, vomiting and slight fever (the highest stand being 38.4° C.

on the second day). Since the fifth day, convalescence went on quite
smoothly. In 12 days the wound healed *per primam*, except the
site of the stump, where some suppuration occurred. About 2 months
after the operation the woman was discharged in best health.—The
microscopical examination (made by Prof. I. F. Klein) showed that the
new growth had a very complex structure: it was a "fibromyoma lipo-
matodes sarcomatodes"—that is, it consisted of non-striated muscle
fibres (principally derived, probably, from the round hepatic ligament),
fatty cells, and sarcomatous elements (to which the rapid growt.. of
the tumor might be attributed), with consecutive tissue stroma.—
Vratch, No. 27, 1890, p. 594.

IV.   Case of "Ideal" Cholecystotomy.   By Prof. Nikolai
V. Sklifosovsky (Moscow, Russia).   A previously always healthy
well-nourished married lady æt. 43 years had been sud lenly seized
with an excruciating pain at a point in 2 fingers' breadth to the right
from the navel.   In about four days the pain had as suddenly ceased,
but shortly afterwards (in August, 1889), the lady had noticed at the
said spot a painless lump of the size of a pigeon's egg which had begun
to ever grow larger since December, 1889.   On examination in March,
1890, there was detected an indolent, tense, oblong, conically-pointed
movable tumor extending from a line in a finger's breadth below the
right costal arch downwards a point in 3 fingers' breadth below, and 2
to the left from, the navel.   The swelling tumor (diagnosed as a dis-
tended gall bladder) was exposed by a vertical incision along the outer
edge of the right rectus abdominis.   The cystic duct proved to be
blocked up by a stone.   All attempts at displacing the concretion
having failed, the gall-bladder was opened by a vertical incision 4
centim. long, and, after removal of the contents (210 cub. 4. of thickly
slimy fluid resembling a rice decoction), the stone dislodged and ex
tracted.   The bladder was then thoroughly washed out with 0.1%
solution of corrosive sublimate, and the cystic wound closed with
deep and superficial fine silk sutures, after which the organ was dropped
into the abdominal cavity, and the abdominal wound similarly closed
with stitches.   The after course was "reproachless," the wound sound-

ly healing about the eleventh day (without any fever). On the fifteenth the patient left the clinic, having been ordered to wear a supporting abdominal bandage for a year. The stone had an ovoid form, measured 3x2 ctm. and weighed 7.5 grammes, its surface being studded with elevations of the size of a hemp seed.— *Vratch*, No. 27, 1890, p. 593.

<div align="right">VALERIUS IDELSON (Berne).</div>

V. The Minute Changes in the Formation of the Umbilical Ring. By DR. W. HERZOG (Munich). Author was induced to undertake the above investigations on account of the peculiar relation existing between the umbilical cicatrix and the hernia in umbilical herniæ. The cicatrix in the majority of the cases is found not on the vertex of the tumor but at the inferior pole of the same on a level with the abdominal walls. Author had a series of sections in fœtuses beginning at the fourth month of fœtal life, to full term. These sections included the abdominal wall, the vein and the umbilical artery as far as the bladder. The most striking fact first noticed was the extraordinary thickness of the adventitia of the vessels. The adventitia of the artery at the very earliest period is 2 or 3 times the thickness of the remaining coats. The tissue of the adventitia is that of loose embryonal connective tissue, exactly similar to the adventitia of the artery of the umbilical cord. The muscular layer is but scant in distribution and extent. The elastic intima in this artery is entirely wanting. The lumen of the vessel on this account is marked by small dilatations and contractions. The above described adventitia is directly continuous with the tissue of the cord.

This can be well seen as the artery enters the cord at the ring. This adventitia loose connective embryonal tissue, which at first is loosely connected with the abdominal ring, becomes converted at a later period just before birth, into firm connective tissue so that the arteries at the umbilical ring are firmly united by this tissue to the sheaths of the recti and to the fibrous expanse of tissue perforated between the recti by the cord. With the veins the conditions are different. The adventitia seen in the arteries is not present. The vein is made up

principally of a media, composed of formed connective tissue, in which muscular fibres are distributed irregularly, both as to location and direc tion. There is neither elastic interna nor elastic fibre, and the lumen of the vessel is very uneven in calibre. The tissue of the cord is not in any way firmly connected with the wall of the vein, either at the umbilicus or in the cord. In the first months of extra-uterine life we find the umbilicus closed, and a mass of connective tissue filling up the whole space between the muscular recti, and uniting the skin above on each side and the sheaths of the recti. In the upper part of this umbilical cicatrix we find a very thin plate of tissue, and beneath this the loose fascia umbilicalis in which are found the obliterated um- bilical vein not in any way connected with the surrounding tissue In longitudinal sections in older children, strong bands of connective tissue seem to pass from the inferior part of the umbilical ring to the skin, while in the superior part of the umbilicus we find weak strands passing to the umbilical cicatrix, which are, however, firmly connected. A hernia would find the least resistance between the inferior connec- tive tissue mass and the upper border of the umbilical ring, and passes in this direction. In this manner the formation of herniæ depends upon the changes which take place around the blood vessels. The umbilicus is not a new structure but simply a conversion of the fœtal embryonal tissue of the cord and its structures into formed connective tissue.—*Beilage zum Centralbl f. Chir.*, N o. 25, 1890

VI. **Operations Upon the Intestine in Cases of Stric- ture and Stenosis with Special Reference to Carcinoma of the Intestine.** By Dr. Koenig (Gottingen). During the past 10 years, 14 laparotomies were performed in cases which were thought to be intestinal stenoses, caused by the presence of intestinal tumors. In one case the obstruction was caused by a bridge of tissue (a band) across the flexura coli, in 13 cases there was disease of the intestines. Ten of these cases were carcinoma of the large intestine, 3 cæcum, 1 colon ascendens, 2 colon transversus, 4 descendens. Two cases were sarcoma of the small intestine, and once stenosing tuberculosis Of these cases 3 were not carried out farther than an exploratory incision.

In 3 cases an artificial anus was establi~hed; of the above, 3 patients died. In seven cases, resection of the gut was performed (in 4 with consecutive suture). Of the latter 4, 2 died. In 3 cases, the pieces of gut could not be united, and an artificial anus was formed. Of these cases, 2 died after operation and 1 died after a year, of a return of disease. The great majority of stenosing tumors are carcinomatous. The most lie adjacent to the abdominal walls, being tumors of the colon, and are movable.

They may be mistaken for tumors of the abdominal wall, when adherent. If they are adherent to the stomach and omentum, the difficulties of diagno~is are increased, the tumors moving with the diaphragm. The symptoms are various; at times increasing constipation, colicky pains caused either by the accumulation of fluid masses in the intestine above the stenosis, or by invaginations in the vicinity of the growth. Hæmorrhages are present in only one half of the cases. The operative treatment is the only effective one. Laparotomy is performed, but whether suture of the gut after extirpation, or resection, or an artificial anus should be done must be decided by the individual case. It also must be indicated in the present status of learning whether the median or lateral incision is the best in laparotomy. Author's experience favors an incision over the tumor. The thickness of the abdominal walls and the covering of fat is to be considered. On exposing the tumor it should be freed from its adhesions and brought outside the abdomen, and operated upon there. The glands, if possible, should be removed from the omentum, though in the same cases it is not possible to remove all the omentum (gangrene of the gut).

The tumor having been brought outside the abdomen, the intestinal temporary sutures are applied, the surface of the gut thickly smeared with boric ointment (so as to insure rapidly flowing off of contents of gut should these escape),and gauze is placed all around the base of the gut. The extirpation of the gut is begun by forcing the fæces into the part to be resected and received over a disinfected basin, then the diseased gut is extirpated well into the healthy region and the parts cleaned. The catgut sutures are passed through the mucosa first, be-

ginning opposite the mesentery and being tied from within as much as possible. Then the sutures into the serosa are applied in the familiar way. Fine catgut or fine silk is used for this latter work. The gut is now cleaned and replaced,and an exact suture placed upon the abdominal wound. In those cases where muscle has been divided peritoneum is first sewed with catgut suture, then the muscle and then the skin-muscle are finally included in a strong silk suture. These remain 3 or 4 weeks.—*Beilage zum Centralbl. f. Chir.*, No. 25, 1890.

VII. Macewen's Radical Operation for Hernia. By Dr. LAUENSTEIN (Hambug). Author had become acquainted with Macewen's operation in 1888, in Glasgow, where Macewen presented two dozen patients of the working class on whom he had operated from 4 to 8 years previously. The patients had continued to perform heavy work since operation, without using a truss, and showed no return of their hernias. At this time Macewen presented a preparation taken from a patient operated on 4 years previously for a large irreducible hernia. The patient had pursued his occupation of barrow-bunter, and had died of a rupture of an aortic aneurysm. On autopsy it was seen that the hernial opening was well closed and strongly supported by the cushions formed of the hernial sac. Macewen's results are as follows: He operated upon 98 cases from March, 1879, to the beginning of 1890; of these 64 were incarcerated (of which 1 was direct and 4 congenital), 16 strangulated inguinal, 4 were non-strangulated and 14 strangulated femoral hernias. Of all these cases only a 3-year old boy died from an attack of scarlet fever at a time when this disease was epidemic in the hospital. Of all the cases, only one in a 3-year old boy with a large irreducible hernia had a bad result. A few days after operation an acute hydrocephalus developed, the wound did not heal and the sutures were removed. The testis was removed twice; once it was cystic, in the other case atrophic. Among the strangulated herniæ was one in a coachman, æt. 52 years, who, 14 days after the operation, lett his bed, and carried a heavy basket; a return of the hernia resulted, which was, however. definitely cured by a second operation. Of all the others, none had a return of disease, though the majority wore no truss.

The author has performed the operation himself during the past 1½ years 14 times. Of these cases 10 were non-incarcerated inguinal hernias, 3 cases were femoral hernias (1 incarcerated), and 1 case umbilical hernia. In the tenth operation for inguinal hernia the vas deferens was accidentally divided. It was re-united with catgut. In one case of inguinal hernia a small abscess formed in the fifth week in the line of suture; in the other cases union by first intention resulted.

The mode of operating by Macewen's method differs from others, first, in the treatment of the hernial sac, and second, in the closure of the hernial opening. The hernial sac is first completely isolated in inguinal hernias, not only in the region of the testis and spermatic cord, but also along the inguinal canal. After the isolation of the sac is completed as far as the internal ring, the operator separates, with the index finger, the parietal peritoneum in the vicinity of the ring to the extent of one-half inch from the fascia transversalis, at the same time finding the relationship between the canal, the cord, and the epigastric artery. A sort of peritoneal free pocket is formed behind the anterior abdominal wall, intended for the reception and adhesion of the cushion formed of the hernial sac. If the sac be empty or the contents reducible, it need not be opened. Adherent contents are treated in the ordinary way after opening of the sac Adherent and irreducible omentum is ligated en masse and the stump dropped into the abdominal cavity. If the sac be large, part may be removed, and the remainder used for the Macewen cushion. The hernial cushion is formed, and its fixation in the abdominal side of the hernial ring occurs as follows: A catgut button suture is passed at the summit of the empty sac, and one end of the suture is allowed to remain long. This suture is passed through an ordinary surgical needle and this suture is passed continuously through both of the walls of the sac, extended tense, as far as the external ring. The surgical needle is now replaced by a Macewen hernia needle, by means of which the suture is passed along the upper wall of the inguinal canal, and on the internal aspect of the abdominal wall, through this about one inch above the inguinal canal from within out through the abdominal parietes, so that the ends of the suture may, if the upper angle of the wound in

the skin is drawn upward, come forward without perforating the skin. The Macewen needle is now removed, and by pulling and shifting from without inward the hernial sac is converted into a folded (curtain-like) cushion which comes to lie on the abdominal side of the internal abdominal ring which is to be closed. The suture is fastened by passing several times through the muscle, or by tying suture   And though the sac is removed from the canal, it is still preserved as a supporting cushion for the abdominal wall.

The second important act, the union of the walls of the inguinal canal with Macewen's quilt suture. The conversion of the cylindrical into a valve-like canal. The hernia needle is threaded with a thick catgut suture, while the index finger of the left hand is passed along the internal surface of the abdominal wall through the canal. The sutures are passed from without inward, and brought out somewhat higher up from within outward, through the internal wall of the inguinal canal (that is the conjoined tendon of the transversus and the oblique internus). Both ends of the suture corresponding to the internal punctures are passed through the external abdominal wall, one through the ligament Pouparti, and the upper one through the musculus transversus obliqus internus, and aponeurosis of the externus. By drawing on the sutures the walls of the canal are brought into apposition. Before tying it is necessary to note that the spermatic cord has not been included in the suture or the sheath of the rectus; the lat er would, by tension, prevent firm union of sutures. In large inguinal canals a second quilted suture may be necessary. The patient is allowed to remain quiet for 6 to 8 weeks; a bandage is not worn, as a rule. In congenital hernias, where the cord cannot be separated from the sac, Macewen separates the former by two longitudinal incisions, by incising the processus vaginalis transversely above the testis. Author has utilized Macewen's ideas in congenital umbilical hernia in that he has, after removing the epidermis witn forceps and scissors, drawn the whole hernial sac inward and placed it on the posterior aspect of the abdominal wall, and then closed the hernial opening with rows of suture. The abdominal wall is thus not opened, except by the entry of suture.—*Beilage z. Centr. f. Chir.*, No. 25, 1890.

VIII. Herniotomy in Cases of Suspected Gangrene of the Intestine.   By Dr. HELFERICH (Greifswald).   It has been the custom, hitherto, in herniotomies to leave the gut suspected to be gangrenous remain in a suitable dressing outside the wound.   This was accompanied by disadvantages; first, the hernial opening in the abdomen had to be enlarged to enable peristalsis to continue unobstructed; this incision amounted to a laparotomy.   Thus the subsequent appearance of a large ventral hernia was favored by the operation.   Again, if the much feared gangrene occurred the patient would have an artificial anus, necessitating subsequent operative interference. Helferich proposes to establish an intestinal anastomosis between that part of the intestine above the gangrenous gut and the part below it. When the anastomosis is completed, the intestine which has been drawn outside of the hernial ring for operation, is replaced.   The part threated with gangrene is allowed to remain outside the hernial opening.   If gangrene occurs, no harm is done.   The peristalsis of the intestine is maintained from the first moment.   The author says the operation is simple, not at all dangerous, and may be performed in exactly similar manner to the operation of gastro-enterostomy.   It may be performed with the aid of Senn's rings, but in the latter case the author fears that the gut, which is already in a reduced condition, may be further endangered by the pressure of rings.   The anastomosis is established opposite the menteric attachment to the extent of about 4 cm. Author advocates sutures.   The suspected gut is resected if it becomes gangrenous, without danger of peritonitis, and the intestinal wound readily closed, and with the established anastomosis peristalsis is completed.   Should the intestine retain its vitality, then no harm is done by the operation of anastomosis; the adhesions to the abdominal peritoneum are loosened around the hernial opening, and the gut replaced into the abdominal cavity.   Author has performed this operation in two cases.   In one case success followed; in the other the patient died in collapse, and autopsy proved satisfactorily that the intestinal anastomosis was complete.   The above operation is recommended for cases of threated gangrene. It is questionable whether it will be of use in actual gangrene of the gut.—*Beilage zum Centr. f. Chir.*, No. 25, 1890.

                                        HENRY KOPLIK (New York).

IX. On the Treatment of Gangrenous Hernia. By DR. POULSEN.   The writer has collected 23 cases of primary resection of the intestine with subsequent suturing of the gut, done in the years 1884–88 (inclusive); of these only 5 died.   But he himself calls atten-tion to the fact that from these one can scarcely draw favorable statis-tic conclusions, as a large number of cases ending fatally are not pub-lished.   Then 31 cases of gangrenous hernia are given, which were treated at the Copenhagen "Kommune Hospital" by pulling for-ward the intestine and forming an artificial anus; only 5 of these are given in full.

He proposes the following method for drawing forward the intestine in gangrenous hernia.   The hernial sac is opened clear up to the ring, the sac and intestine are well cleansed with some dilute antiseptic, small perforations are closed provisorily.   Then the abdominal wall is slit up 2 or 3 centimetres and the peritoneum stitched to the skin. Then the gut is drawn forwards 5, 10 or even 15 centimetres beyond the gangrenous portion; after a portion has been drawn out it should not be pushed in again.   If peritonitis be present the peritoneal cavity should be washed out.   The gut is fixed by silk sutures so that the 2 intestinal tubes are near each other.   The gangrenous hernial sac is removed, but the gut drawn out is left (intact) and packed in iodoform gauze, which also is pushed in towards the mouth of the hernial sac. One to two days later the extracted coil of intestine is removed, best perhaps by means of Paquelin's thermo-cautery.   As soon as the gan-grenous portion is cast off enterotomy is performed and subsequently enteroplasty.—*Hospitals Tidende.* R 3, bd. 7, p. 349, 373.

F. H. PRITCHARD (Boston).

THE MÜTTER LECTURES ON SELECTED TOPICS IN SURGICAL PATHOLOGY.

SERIES OF 1890-1.[1]

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LECTURE I.

INTRODUCTION.—*Ever-growing importance of the study of Surgical Pathology. Lessons to be learned from the life-work of eminent observers.*

The inflammatory process: its varieties. Granulomatous inflammation. Thrombi; varieties and how formed. Traumatic anæmia. Hæmoglobin and oligochromæmia. Aerobic and anaerobic life of the organism, and chemical products of the same. Ptomaines and leucomaines; classification and definition of same. Toxines. Proof of formation of ptomaines by bacterial action.

Classification of infectious diseases. Surgical infections and discussion of conditions predisposing to them. Embolism as one of these conditions. General depression of vitality. Local depression. Influence of inflammation; of cold; of injury.

IT WILL not be amiss if at the opening of the present course, the lecturer prefaces its more technical portion with a few words concerning the present advanced stage of surgical progress, and the causes which have contributed thereto. If we call before our minds the really great surgeons of to-day, or of the present generation, and ask ourselves by virtue of what particular attributes they have become great, we shall satisfy ourselves that they are not only good anatomists, and men of

[1]Delivered before the College of Physicians, Philadelphia, December, 1890.

broad general attainments, not only are they all—or nearly all—brilliant operators; but more, much more than this, they are all good physiologists, and especially, good *pathologists.*

Sound and tenable pathology is to-day as essential for the surgeon as for the physician; one needs it as much as the other. If at this time there is any one respect in which the continental surgeons eclipse those of our country, it is in this. Better anatomists they are not—certainly not better operators—for the most part not as good. But by virtue óf their early training, and by the influence of tradition and surrounding, they are reared in an atmosphere—so to speak—of pathological interest and lore; they imbibe it as part of their daily increment of knowledge, and hence they acquire whatever element of superiority they may enjoy over their American *confreres.* It is hardly my business, nor is it my purpose here to try to point out the reasons for this state of affairs, nor to suggest remedies.

But I can do no greater service to the younger men to whose notice these words may come than by every means, and by every argument in my power, impressing and insisting upon their conviction that the early years of their medical studies constitute the golden opportunity for laying in that store of elementary knowledge of normal and morbid physiology, *i. e.,* pathology, and of that familiarity with instruments of research and of technical methods, which shall prove of inestimable advantage to them a little later. How many men whom we could name at once have fallen just short of greatness because of deficiency in this respect! And what a magnificent future lies before succeeding generations of surgeons, if they will but properly prepare themselves for it!

Langenbeck, who well deserved the proud title of Nestor of recent German surgeons, did no greater service for surgery than when he brought to his professional surgical chair the practical knowledge of physiology which he had acquired by teaching it, and introduced into his akiurgical instruction the experimental method as the two never had been combined before. By this method, as it was practiced by him and his pupils, there was brought about almost a second *renaissance* of surgery; while its conspicuous advantages turned the tide of

surgical travelers from London and Paris toward Germany, and put German teaching—of this branch of the healing art—so far ahead that even to-day those who would not go to Germany have no need to leave this country for the acquisition of such knowledge. Outside of Germany the same is true in little less noticeable degree. The two London surgeons, most honored of all, at home and abroad, are Sir James Paget and Mr. Jonathan Hutchinson; and of the French no man's opinion carries more weight than does that of Verneuil or of Ollier. Yet if I were asked whether these men rank higher as surgeons or as pathologists, I should unhesitatingly say as the latter. And no better illustration of the soundness of my position did America ever afford than was furnished here in your own city by the distinguished Gross. No one at all familiar with his life and work can deny that his greatness and his accuracy as a surgeon were in very large measure due to the attention he paid to pathology during his early years, or indeed all his life. A cursory examination of his early textbook on this subject will be convincing in this respect.

Aside from the ordinary knowledge and ability, which, by common consent, every surgeon deserving the name should possess, it seems to me that the cultus of the day demands that hereafter none should be deemed competent to practice surgery who have not had competent and abundant training along the lines of

1. Experimental physiology and pathology.
2. Pathological histology and general pathology, including
3. Bacteriology.

It cannot be considered as improper or too personal if I mention a few individuals among living surgeons, whose work illustrates forcibly the advantage of such training. I know of no one who has more happily combined the dexterity of the accomplished surgeon with the training and education of the expert physiologist than Mr. Victor Horsley. As first an assistant to Prof. Burdon Sanderson, he acquired that familiarity with the endurance of living tissues, and the minute functions of the various organs, which has enabled him to make his operations upon the human patient the marvel and the admiration of contemporary surgeons. So with the leader of the

Austrian surgeons, Billroth, and notably with his best known
pupils, like Czerny, Gussenbauer, Wölfler and others. So too
in the highest degree with that great Lyons master of bone-
surgery, Ollier, whose volumes bristle with facts attesting his
devotion to the experimental method.

Among living surgeon-histologists no names better deserve
mention perhaps than those of Paget, of Lannelongue and
Butlin.   Volkmann led here, as he did in every other depart-
ment, and, though now he rests from his labors, is entitled to
be named with the others who were his contemporaries.

Of surgeon bacteriologists perhaps the best known are
Rosenbach and Fehleisen, though Cheyne and Neisser, with
others equally deserving, are scarcely less known.

Nor must we forget what home surgeons are doing in these
various fields, for such names as those of Parkes, Senn, Hal-
stead and Warren must be written in large letters on this par-
ticular tablet of surgical history.

Pathology, then, is a *sine qua non* for the modern surgeon,
and everything which fosters fondness for, and familiarity with,
it should meet with hearty encouragement. To this end it
must assume an ever-increasing importance in every college
curriculum, and to this end also every such collection as the
invaluable one which this college contains should be daily
haunted, and no opportunity of securing and preparing speci-
mens for private or public collections should be neglected.
Above all things, the many opportunities for study of compar-
ative pathology, both natural and experimental, which are
constantly afforded, both in city and country, should be util-
ized to the fullest possible extent.

The most brilliant illustration of what such study may do
for one is afforded in the person of Mr. J. Bland Sutton, who
stands to-day a young man, yet one of the most prominent
figures, in my estimation, among pathologists, living or dead;
who has made thousands of autopsies upon animals, the num-
ber including nearly every known genus, who has contributed
to the magnificent collection of the Royal College of Surgeons
some of its most valuable specimens, and who in tastes and
acquirements well deserves to be considered the legitimate
successor of John Hunter.   He, practising and now working

as a surgeon, has, nevertheless, almost created the science of comparative pathology; and it is to be earnestly hoped that he may be induced to undertake a systematic treatise upon this subject—which as yet does not exist in any language. Of the value—surgical and pathological—of his writings, only those can speak who have read them, as all ought to have done. I think he will pardon me if I place his career before you as one which is deserving alike of greatest praise and closest possible imitation.

To this end, also, the founder of this course of lectures, with that wisdom and foresight for which he was so distinguished, ordained that they should be devoted to topics connected with surgical pathology. Although the field is immense, the number of laborers in it is correspondingly large, and it has been my aim less to intrude upon you personal views and experiences, or statements of personal work, than to collate and compare the results of investigators the world over, and to invite your attention to the present state of knowledge concerning some of the most contested or most important and interesting topics to-day discussed or considered by the surgical profession.

I have in my library an interleaved copy of a "Syllabus of the Course of Lectures on the Principles and Practice of Surgery, Delivered in the Jefferson Medical College," by Thomas D. Mütter, M.D., published in 1847, with copious notes, interlineations and annotations by Prof. Howard Rand. I have been much interested in looking over the note headings to see the extent of its author's erudition in the surgical pathology of his day, and the attention which he compelled his students to devote to it, and have often thought how well it would be if some of the surgical teachers of to-day would more closely imitate him in this respect. To be sure, there is much therein which needs elision, revision or contradiction, such as the statement on page 10, that suppuration can occur in 35 minutes; yet the whole syllabus so clearly indicates the character of his teaching and his bent of thought, that one scarcely wonders at the general drift which he so wisely insisted this course of lectures should assume.

Inasmuch, therefore, as all pathological processes begin

with alteration of nutrition, of cell activity and of the constitu-
tion of the vital fluids, it has seemed wise to first discuss a few
of the more important of these changes in the light of recent
studies; in other words, to begin in our studies of surgical dis-
ease where nature appears to begin in its production.

The inflammatory process is modified according to condi-
tions of environment and cause, and may be classified under
four different headings—as regenerative, productive, exuda-
tive and destructive. The *regenerative* form especially con-
cerns the surgeon in the matter of healing of wounds. It is
always followed in every case, and in whatever disease, by ci-
catrization. *Productive* inflammation is met with after injuries
or destruction of particular tissues; is at times adhesive, at
times hyperplastic. *Exudative* inflammation is serous, sero-
fibrinous and sero-hæmorrhagic. *Destructive* inflammation is
either suppurative or gangrenous, or both. To these four
forms might perhaps be added a fifth, the *granulomatous* in-
flammation, of which we shall later speak more at length.

To the serous form of exudative inflammation there has been
given the name of inflammatory œdema. This must be sharply
distinguished from those forms of œdema which are due to
mechanical disturbances of the circulation. When the blood
stream is interfered with in the veins, while the arterial stream
is circulating in full force, there must occur stasis in the capil-
lary veins. Under these circumstances serum is forced through
the distended vessels and into the tissues, and there fills the
intercellular spaces and minute canals. This form of œdema
is as different from inflammatory as is blood serum from
blood. In the mechanical form the serum is poor in fibrin,
while in the inflammatory form it contains not only fibrin, but
the other elements of the blood. Serous inflammations of
higher grade which contain a relatively large percentage of
fibrin are known as sero-fibrinous. The flocculent precipitate
of fibrin is produced by a mutual reaction of fibrinogin and
fibrino-plastin, just as they produce blood clot under other cir-
cumstances. In rare cases there is added to the exudate of
serous inflammation the red blood corpuscle element. When
this is in excess it is known sometimes as hæmorrhage by dia-
pedesis. The ordinary termination of exudative inflamma-

tion is a complete return to the normal standard. In a small proportion of cases, especially involving serous cavities, there remains a portion of the exudate, which predisposes the part to a recurrence of the trouble.

Rapid progressive inflammation leads not infrequently to stasis and to coagulation of the blood in surrounding tissues or in the smaller arteries. If now the collateral circulation is sufficient resorption is still possible; if not, local gangrene is the result. Around the margin of such a gangrenous focus there will always be a zone of suppuration which may be taken as an instance of *pyo-gangrenous* inflammation. It is not necessary to have inflammation of the highest grade in order to produce gangrene; it is frequently enough to have the supply of nutritive material shut off. Thus one sees often, even in a simple case of this kind, considerable portions of tendon slough off, since the tendon contains no blood vessels, but only canals through which nutrition is furnished by osmo-is. Should such an inflammation progress to the neighboring muscles, it loses its gangrenous character in all probability, since here blood vessels supply the proper nourishment. For gangrene of muscles ordinarily, the highest grade of diphtheritic inflammation is necessary.

Granulomatous inflammations.—These are always chronic processes. One sees them confined almost to individuals of peculiar constitutional condition, such as are usually grouped under the head of the scrofulous, the syphilitic or the leprous. In contra-distinction to the serous and purulent forms of inflammation, these have little or nothing to do with skin lesions or access of air to the tissues. They are produced rather without injuries, and in those cases in which injury is alleged, it is usually of the nature of a deeper crushing without cutaneous lesion. Most of these cases pertain to the period of youth. Most commonly the bone marrow is involved, and it seems as if the marrow of growing bone were peculiarly liable to this affection. Still, granulomatous inflammation of the skin is common, as well as in joint cavities. If we examine a piece of tissue from the beginning of a granulomatous inflammation macroscopically and microscopically, and compare it with a small fragment from a case of purulent inflammation,

we shall not find any marked difference; both consist of new blood vessels with heaps of small round cells between them. In their further course, however, the difference notably increases. The granulation tissue in the neighborhood of the acute abscess is a great help to its subsequent healing. In the other case, however, the cells break down after infection, and form small abscesses which frequently coalesce, and these form others of considerable size, which pursue the well known course of the sub-acute or cold forms. As the result of spontaneous perforation of these latter we have granulating ulcers and fistulous passages of an ulcerative character, which may lead deeply, even down to the bone marrow. The significant feature of granulomatous inflammation is, that it never tends to formation of a firm cicatrix or healing; it tends to remain indolent, or to become more. and more destructive. Its destructive products are never natural pus; they contain fragments which have a caseous appearance, and they lead to so-called caseous degeneration, or, through fatty degeneration, we may meet with veritable fat balls in its substance. There occurs a complete transformation of albuminoid, nitrogenous substances, into those which are fatty and free from nitrogen.

Any synopsis of the forms of inflammation leads by a path which cannot be avoided to the topic of thrombi and thrombosis, and indeed the question of the formation of thrombi is one of such universal interest, since thrombi have so much to do with surgical diseases, that it will be well to stop to consider briefly how, and under what circumstances, they are most often formed. The first variety of which we shall speak, following Klebs, is the coagulation of fibrinous form, the second that which is formed from red cells and globulin; the third that from leucocytes; yet another is formed from hæmatocytes, and a fifth is produced through the instrumentality of the hæmatoblasts, or the third corpuscular element of the blood. Each of these forms may be met with by itself, but mainly we have to deal with mixed thrombi.

A. *Fibrinous thrombi.*—Fibrin is the principal material out of which these are formed, and this possesses the property of adhering to the vascular wall, which naturally appears to be the first requisite of thrombus formation. This is the form

which most commonly gives rise to secondary thrombosis or embolism. The cases in which a simple separation of fibrin from the circulating blood occurs by itself are rare; some foreign body in the circulation is usually the prime cause. A roughness of vascular surface has been supposed to be sufficient to favor coagulation of the fibrin, but the condition of atheroma of the vessels, by which their interior is roughened, does not lead to thrombosis as often as would be expected. The death of the vascular wall, whose life is an important cause of the fluidity of the blood, does not invariably lead to thrombosis, as the uncovered calcareous plates of the interior of the vessels will prove. Even cauterization of limited areas of vessel walls does not necessarily always produce thrombosis; neither does ligature of vessels. On the other hand when fibrin ferment is introduced into the circulation, or when the same is set free in the blood, as may be done by injections of ether, we have most extensive thrombus formation. This naturally raises the question whether such a thing can occur under natural conditions, and this has hardly yet been answered definitely. The thrombi which form in the heart during the last moments of life can hardly be considered to have formed under natural conditions. There is considerable reason to think that in septic conditions the fibrin ferment of the patient's blood is altered in amount or activity.

B. *Hæmatoblastic or globulin thrombi.*—The third corpuscular element of the blood is now well known, although whether it be a normal constituent, or an intermediate or retrograde form, is hardly yet decided. Without discussing to any extent the conditions under which thrombi are produced by the action of these corpuscles, we have to side either with those who consider them to be normal blood elements, and recognize under what pathological or physiological conditions they increase, or else we must deny that they are normally present. Hayem found a significant increase after ingestion of food, but in pathological conditions different observers have obtained so widely varying results that it is impossible, as yet, to assign to them any distinct role. Here, again, we must allude to the fact that the cauterization of areas of vascular walls does not necessarily lead to thrombosis, with the exception of those

points at which a loosening of the cauterized scale leads to
some unevenness of the surface.   Even at these points it does
not always occur.   Evidently then when thrombosis does here
occur, some condition not obtaining in the vessel wall itself
must lead to it.   Perhaps the rapidity of the blood stream has
much to do with it; but more important, probably, is the part
played by this third corpuscular element. It has hitherto been
very difficult to experiment with this, since the conditions of
the experiment inevitably lead to inflammation of the areas
under observation.   However, Lowit has recently succeeded
in examining the mesentery of mice under castor oil, by which
no inflammation is produced, and by means of which he was
able to convince himself of the absence of hæmatoblasts at
points where the circulation was slackened.   Slight cauteriza-
tions of the vessels with points of nitrate of silver produced
hæmatoblastic thrombi, which contained leucocytes, and which
broke loose and were rapidly reformed at the same points; and
he was even able to observe the breaking down or disintegra-
tion of the stagnant, red corpuscles. The leucocytes also broke
up, after a time, as Zahn has already described.

   C.   *White or leucocyte thrombi.*—These were long ago recog-
nized by Virchow as a separation of the white corpuscles,
which earlier authors had held to be pus corpuscles, taking place
where a slowing of the circulation leads to thrombosis. In such
cases, as Cohnheim showed, the white corpuscles leave the more
rapid central stream, and attach themselves to the surface of the
vessel wall, especially at those points where circumstances fa-
vor, as the point of division of the vessel, or where a sudden
curve or dilatation leads to stagnation of the current.   Other
favoring circumstances are changes in the intima, such as
roughening or minute alterations of the endothelium by which
exudation is more easily permitted.   Thrombi formed by leu-
cocytes alone are relatively rare, a leucocyte immigration into
a fibrinous thrombus naturally being included under this term.
They are most common in cases of leucæmia in which the
capillaries of the mucous membranes, especially of the intes-
tines and nose, are filled with them and made to resemble
white streaks. They occur also in the rear of some emboli when
the section of the occluded vessel behind them is very short;

also behind venous valves and in the spaces between the bundles of muscle fibres in the heart, and in the sheltered cavities which form in connection with aneurisms and varices. They may also form in slowly circulating blood as free thrombi.

D. *Red blood corpuscle or hæmatocyte thrombi.*—Constituted primarily from adhesion of the red corpuscles. This is a genuine stagnation form. Aside from stagnation, a second condition, namely the removal of the blood plasma from the stagnant blood mass, is a contributing feature. It takes place also when pressure is exercised upon the red corpuscles. White corpuscles which are entangled with the red are usually destroyed or lose their identity. The pure stagnation thrombi are usually formed at those points where a good-sized vascular area is shut out, as for example, after the ligature of a vein of some size. Under these circumstances the arteries are dilated and the collateral circulation easily takes off the overflow. All so-called ischæmic conditions, depending upon arterial contraction, can cause stagnation thrombi if they occur in a region whose veins are enlarged and filled with plenty of blood. The essential condition of the stagnation thrombus, the lessening of venous flow, is always accompanied by an increase of pressure in the capillaries and veins, and it is this which determines an increase of exudation, and this in turn leads to a typical œdema. General or partial venous stasis furnishes all the necessary requirements for the formation of hæmatocyte thrombi. Very typical forms of these are met with in senile gangrene; so also contusions and inflammations of injured portions produce the same effect. Especially unfavorable is the extension of inflammatory processes along the arteries, by which are produced extensions of thrombi, mostly in the shape of fibrinous additions. A marked instance of these thrombi is met with often in the so-called arterio-venous aneurism, that is, the traumatic communication between an artery and a vein. There belong also in this category a large number of divers forms resulting from venous stasis combined with hæmorrhage, such, for instance, as occur about the constriction in a case of strangulated hernia. Such conditions lead frequently to so-called hæmorrhagic gangrene. So far as the future of these

thrombi is concerned it is not necessarily unfavorable so long as further changes in an undesirable direction do not occur, since with improvement of the circulation compensatory and absorbtive processes are instituted; but if they exist too long there occur changes in the character of organization, or, if infected, in a destructive direction.

E.   *The mixed or the thrombus in layers.*—These layers, as is well known, are formed by deposition at different times of the solid material of the blood, this material being now of one of the above forms, at other times of another.   The surgeon meets with this variety most commonly in dealing with aneurisms or hæmatomata, in which concentric deposits from contained fluid have taken place.   In another signification the mixed forms are met with often in those thrombi which obliterate vessels.

As appears above, explanation of some of these forms of thrombus-formation is simple, at other times it is difficult, or as yet impossible.   Remembering how rapidly blood coagulates outside the body, remembering, too, what differences may be observed, in this respect, in the blood of different patients, it will be seen that it can scarcely be expected of us to imitate outside of the living body the conditions existing within it, nor to solve all the problems of vital chemistry.

Nevertheless, a distinct advance has been made, first in the ecognition, and then the accurate study of ptomaines and leucomaines, and there is now every reason to think—nay, to state with little or no reserve, that there often takes place a form of ptomaine or leucomaine intoxication, analogous to that produced experimentally by certain substances, such as the fibrin ferment; and that under these circumstances there may occur an almost instantaneous and extensive thrombosis, or analogous change, wherever the poison reaches.   Surely in this way are we to account for the altered quality of the blood so universally recognized and commented on as among the changes during and after death from the various infectious diseases.   So large a part in the pathology of the blood is now borne by these alkaloid substances and toxines that to them we must presently devote some attention.

But, dealing still with the blood and its natural constituents,

for a few moments, let us see what recent research has shown us concerning blood loss, and how it is atoned for.

In cases of traumatic anæmia there is a relative or rather an absolute *decrease* of leucocytes. Ehrlich has shown that 80% of white corpuscles are formed from lymphocytes, while the balance are represented by multinuclear neutrophile, or mononuclear neutrophile cells and transition forms, in the proportion of 14, 3, and 3%. His eosinophile cells are formed solely and normally from bone marrow. The decrease in number of leucocytes in traumatic anæmia is due to failure of equilibrium between the true lymphatic structures on the one hand and the spurious, like the spleen and the bone marrow, on the other. Cohnheim some time since showed how in cases of acute anæmia following injury the bone marrow tends to revert to the embryonic condition, and its failure to produce these cells may, perhaps, be explained in this way. They constitute a definite constituent of normal blood, and are found in proportion of 2 to 4%, which may even increase to 10%. Their complete absence, therefore, points to a disturbance of function, at least in bone marrow.

As a matter of common interest we may add here that the character of a given case of anæmia may be largely determined by a study of the red corpuscles. In all severe forms nucleated red cells are found, which bespeak an active regenerative process. In secondary anæmias these nucleated corpuscles have normal size, and may be called normo-blasts; while in the pernicious forms they have a much larger size, corresponding to embryonal types, and may be called giganto blasts. This method of differential diagnosis is, indeed, recommended by Ehrlich as the safest of all.[1] Possibly this fact also finds its explanation in the above-mentioned discovery of Cohnheim.

Hæmoglobin. That the amount of hæmoglobin in the blood varies within wide limits under different conditions has been known for some time, yet it is only recently that a careful

[1] By far the best method of examining these various blood-cells is that known as Ehrlich's double-staining, the aniline dyes employed consisting of acid fuchsin, methyl green and orange green.

study of the amount present in various surgical diseases has been determined. At the Congress of German Surgeons of 1890, Mikulicz presented the results of a study of some 400 cases, mostly operative. Two questions especially concerned him. First, in what time after serious loss of blood in man does regeneration occur, and what influences thereupon have age and sex; second, in relation to those diseases which we are inclined to associate with a vitiated constitution, what striking variations have we in the amount of hæmoglobin in the blood, and its regeneration after hæmorrhage? The first question has been studied in animals from many sides, but only a few observations have been made in man. Concerning the second question, Leichtenstern and Laker have offered some interesting observations, but only in relation to tuberculosis. Mikulicz perceived during the examinatson that the estimation of the actual blood loss depended on manifold factors. In the case of each disease the amount of hæmoglobin had been determined before the operation as well as afterward at stated intervals, say at two or three days. The amount of the loss of blood found expression in the percentage determined from the original amount of hæmoglobin in the blood, while the gradual increase of the latter explains the augmented blood regeneration.

The estimation of the hæmoglobin was made by Fleischl's hæmometer. This instrument is easily handled, and permits an estimation in from three to five minutes. Personal equation produces error of from 2% to 5%. The subjoined table gives a summary of the amount of hæmoglobin and of blood regeneration, that is restoration to previous or normal standard, with reference to sex and age. It was made up from observation of one hundred and seventy-five patients who presented no so-called constitutional disease.

The ideal normal standard of 100% was discovered with Fleischl's instrument only in a few individual instances of strong young men in the third decade of life. The general average is considerably lower, the highest average appeared in men in the third decade of life, viz., 92%. This may be partly explained by the fact that persons presenting at a public clinic are scarcely to be considered as highest types of their class.

The female sex shows a smaller amount of hæmoglobin in the blood than the male. The different averages given here—about agree with the tables of Sterling, viz., males, 87.8, females, 84.5.

TABLE I.—THE AMOUNT OF HÆMOGLOBIN AND BLOOD REGENERATION WITH RESPECT TO AGE AND SEX.

Age.	AMOUNT OF HÆMOGLOBIN.			BLOOD REGENERATION.		
	Males and Females.	Males.	Females.	Males and Females	Males.	Females.
	Per cent.	Per cent.	Per cent.	Days.	Days.	Days.
1–10 years........	73.8	74	73	22.4	20	25.5
10–20 years	82	83	81	17	15	18.5
20–30 years........	88.7	92	80.7	11.6	10.6	17.7
30–40 years........	84	88	76.6	12.5	11	14
40–50 years..	82	84	78	18	14	2
50–60 years........	84.8	88.6	79	20.6	18	24
60 and above......	83	85	78	25	24.5	29
Average.......	81.6	83	78	17	15.6	20.4

Sterling's examinations were made with Gower's instrument which gives a higher value than does that of Fleischl. Some striking differences appeared in reference to the speed of regeneration of lost hæmoglobin. The most rapid occurs in the third or fourth decades of life, it being much lower with children and the aged. This corresponds with the clinical experience that the very young or old bear loss of blood more poorly than do those of middle age. It also appears that females are considerably behind males in the same respects. With women in the third decade of life the average time of regeneration of 14.7 days agrees well with the observations on puerperal patients by Meyer, who observed within 14 days a permanent and complete restoration of the normal standard. The amount of blood lost also influences the result. Blood-

loss which was indicated by 15% loss of hæmoglobin was, on
the average, atoned for in 14 days, by 20% blood loss in 20
days, by 25% blood loss in 21 days, and all proportions over
25% of blood loss required on an average 29 days for res-
toration.

The minimum proportion of hæmoglobin reappears first
after several days, quite in conformity with observations on
animals.   The greater the amount of blood lost, the later ap-
pears this minimum.   When the blood-loss is up to 15%, this
time is three and one-half days; with blood losses over 25% it
averages nearly ten. The greatest loss of hæmoglobin ap-
peared in a woman who had undergone extirpation from the
abdominal wall of a large fibroma weighing some 30 pounds.
Her proportion of hæmoglobin sank from 70% to 22%.

Regarding the largest losses of blood which men can stand,
these appear to depend less upon actual loss of hæmoglobin
than upon how much hæmoglobin still remains in the body.
The minimum amount in a single patient after a major opera-
tion amounted to about 20%. In three cases dying of collapse
this amount sank to about 15%.

Mikulicz believes that many of the cases dying on the sec-
ond or third day after severe operation from so-called collapse
are to be attributed to oligo-chromæmia, i. e., deficiency of
hæmoglobin in the blood.   It is quite possible that an expert
in these examinations might, from an estimation of hæmo-
globin, give a reliable judgment as to whether in a given case
the patient could or could not withstand a severe operation.
In eleven cases estimations were undertaken just before and
just after operating, in order to determine the effect of mental
emotion, narcosis, etc.   In every case there was found a loss
of from 5% to 10%, from which it is easy to decide that
chloroform narcosis exerts a decided influence upon the blood.

Table II gives a review of the amount of hæmoglobin and
the regeneration period with different diseases which exercise
more or less vital disturbance or which stand in causal relation
with cachexia or dyscrasia.   In seventy-nine cases of local
tuberculosis where the hæmoglobin averaged 63% as against
81.6% normal, the period of regeneration was delayed at least
a week.   Delay was most conspicuous in cases of tubercular

diseases of the lower extremities, least so with those of the
soft parts.   It is likely that every such lesion by which func-
tional disturbances and impaired nutrition are caused must in-

TABLE II.—THE AMOUNT OF HÆMOGLOBIN AND THE BLOOD REGENER-
ATED WITH RESPECT TO CONSTITUTION.

Cases	Disease.	Amount of Hæmo-globin before Op-erating.	Blood loss in per cent of the Hæmoglobin Reduction.	Regeneration.
		Per cent.	Per cent.	Days.
1	Healthy......	81.6	15.5	17
2	Tuberculosis:			
	a. Altogether	63	14.7	24
	b. Bone.................	....	15.5	....
	Lower extremi'y.........	60	15 5	26
	Soft parts	70	13	17
3	Actinomycosis,....	46	....	....
4	Syphilis, tertiary.	55.4	15.4	18
5	Benign tumors:			
	a. Altogether............	79	17.4	18.8
	b. Without compl.cation.	83	15	16.8
	c. With rapid growth or of considerable size...	70	23.8	24.6
	d. With functional distur-bances or putrefaction.	67.5	14.6	16.6
6	Malignant tumors:			
	a. Altogether............	60	17.2	26
	b. Without complication.	68.5	15.5	23
	c. With rapid growth or of considerable size...	56.6	18.2	27.8
	d. With functional distur-bances or putrefaction.	57.6	17.8	27

fluence the condition of the blood.   Laker also obtained simi-
lar results.   The question whether tuberculosis as such influ-
ences the amount of hæmoglobin in the blood, or whether the

descendant of a family characterized by a minimum of hæmo-
globin is thereby predisposed to tuberculosis, cannot yet be
answered from data at hand; but it is hardly likely.   Certainly
Mikulicz found that, in a series of cases, after complete heal-
ing of local tubercular trouble the amount of hæmoglobin rose
far above the original height.   On the contrary, in several
cases in which the disease could be only incompletely removed,
or where relapse occurred, the proportion of hæmoglobin did
not attain the original height.

In ten patients with tertiary syphilis the amount was con-
siderably reduced, though the regeneration period was unin-
terfered with.   In four severe cases of actinomycosis the
amount was still smaller.   Finally, in thirty-two cases of be-
nign, and seventy-two cases of malignant tumors, divided into
three categories, *a*, uncomplicated tumors; *b*, those of rapid
growth, of considerable size, or of severe hæmorrhages; *c*, those
which were breaking down, or causing severe functional dis-
turbances, as pressure upon the trachea or alimentary canal,
the average amount of hæmoglobin in the benign tumors was
reduced but very little from the normal; while in the first
group the average was even higher than the normal, and in the
second and third it was more or less reduced.   The most
striking reduction was in a case of large goitre causing severe
compression of the trachea.   In malignant tumors the average
is reduced to about 60%.   The statistics of Mikulicz concern-
ing cases of mammary cancer, agree with those of Schmidt, of
Heidelberg, who estimated it at from 50% to 60%.   In malig-
nant cases also the period of complete regeneration is materi-
ally retarded.   Furthermore it was found that incomplete re-
moval or recurrence prevented a typical regeneration or res-
toration to the proportion present before the operation, while
after successful radical removal complete restoration to the
previous standard was obtained, with sometimes positive gain.
A woman who had gained thirty pounds after resection of a
cancerous pylorus, showed after three months hæmoglobin to
the amount of 65%.   It would appear, therefore, as if some
prognostic significance might be attached to an accurate esti-
mation of hæmoglobin at intervals after removal of malignant
tumors.

Everywhere, and until recently by all, the animal organism has been supposed to be one which could not live without air. It may well be one of the proud boasts of this present generation that it has shown that life of a complex organism is made up of the life of its component parts, mainly animal cells, and that, as Gautier has shown, at least one-fifth of it is *anærobic*. In other words, not all vital force comes from combustion, nor from the *ærobic* life of cells. But whether they need or eschew oxygen, the cells excrete products which must be expelled from the organization, else would the animal quickly succumb, were the carbonic dioxide, the urea, the water, or even the heat, which it produces, allowed to accumulate within itself. The products of ærobic life are poisonous and inimical enough, but those of its anærobic vitality are peculiarly so. They are of the same character as those which result from all bacterial activity, toxic, and for the most part, alkaloidal. Those of this class, constantly present in prolonged or violent putrefactive changes, belong to the pyridic and hydropyridic series, differing little from the bases of hemlock and tobacco; and even more powerfully poisonous substances are met with under similar conditions, such as muscarine. Since, then, we live anærobically, in part, we may expect to find such analogous substances as may result from the splitting up of albumenoid bodies, and these are the leucomaines. Let me here quote Gautier verbatim:

"The products of life, ærobic and anærobic, can not be retained within the organism for any length of time with impunity; normally, they undergo destruction and excretion by economic processes which are constantly in operation. But if from any cause the functional play is interrupted, should there be emotional disturbance of the nervous centres; should sudden chills suppress the action of the skin, or insufficient æration take place; or, if, finally, from any less obvious cause, leucomaine products be more abundantly formed within the cells, or be so defectively absorbed, excreted or oxidized as that the blood becomes charged with them, they are carried to the nervous centres, which regulate the central life and function as a whole; immediately disorder becomes general, complete, and necessarily assumes progressive forms —in a word, disease de-

clares itself and undergoes development."—(Preface to Brown's "Animal Alkaloids.")

Like our proper cells ferments or specific microbes live— some of them—anærobically, as those of tetanus, malignant œdema, and some forms of septicæmia; while others live ærobically, like those of anthrax, pneumonia, etc. Others yet possess facultative powers in both directions, like tubercle bacilli. But each and every one *must* excrete, and ptomaines and leucomaines, like carbonic dioxide and urea, are the residual products of life, solid, liquid or gaseous, effete and pernicious, which may become the cause of disease, or may accompany it and mask the prime cause; and such they are, whether arising from the normal cells of the organism from within, or in the microbic cell introduced from without. Once set free within the system our tissues make no fine distinctions of origin or intended destination, but suffer in proportion to dosage of poison and susceptibility thereto.

We shall have to recur to this subject when dealing with the matter of surgical sepsis, so can afford to dismiss this aspect of it here, delaying only for the sake of definition and classification.

To follow all the chemical changes which the complex tissue molecule may undergo would be too foreign to our intent this evening. Yet it is not enough to merely say that a ptomaine is the alkaloidal waste product of a cell; it is in reality much more than this, since it represents the final production of a series of cyclical changes which represent tremendous cellular activity. Brown sums up the idea tersely when he says:

"A ptomaine thus presents itself as the residual skeleton, as it were, of the proteid molecule, which has undergone continuous disintegrative action, the ultimate terms of which are represented by the pyridic bases; so that, considered from a purely chemical point of view, a ptomaine may be defined as the cyclical nucleus of a proteid molecule, that has undergone complete destruction in the process of putrefaction."

The essential idea conveyed in the term is, then, that of *putrefactive* change, *i. e.*, one begun by cells introduced from without, and having no place in the healthy body, when everything is working smoothly.

On the other hand, it has been amply shown, not alone by Gautier, that the important chemical function of all animal tissue is the incessant elaboration of alkaloidal products formed at the expense of proteid material, just as carbonic dioxide and urea are simultaneously formed. Upon these vital and essential alkaloids, Gautier conferred the name leucomaines, which term he limits to those derived from albuminoid substance and formed in the living organism and before its death. It does not necessarily follow from this that the same base may not appear at one time as ptomaine, at another as a leucomaine, though this must occur comparatively seldom.

It will prove germane to our subject if we pause here to give a list of these alkaloids and bases, as well as to speak of a few other substances which, for lack of a better category in which to place them, we may call toxines.

Schwalbe, following a convenient and recognized system, has classified ptomaines and leucomaines as follows (*Deutsche Med. Woch.*, 1890, No. 36):

A. Ptomaines free from oxygen, whose bacteria are not yet known. —These persist throughout putrefactive activity.

Collidin ($C^8H^{11}N$). Isolated by Nencki, and regarded by him as isophenylethylamin. Appears to be formed only by a mixture of gelatin and hog's pancreas.

Pawolin ($C^9H^{13}N$). Separated from putrefying mackarel by Gautier and Etard.

Hydrocollidin ($C^8H^{13}N$). From the same; 7 mgr. kill a bird, with tetanic cramps.

Dihydrocollidin. Discovered by Cahours and Etard; made by treating nicotin with selenium

Neuridin ($C^5H^{14}N^2$). Found by Brieger in numerous rotting substances. Appears in putrefying human flesh in 3 days, increases to the 15th day, and then disappears. When absolutely pure is not toxic.

Cadaverin ($C^5H^{16}N^2$). Appears after 3 days in putrefying human flesh. Bocklisch found it in herring-brine, and in cultures of the Finkler-Prior bacillus. Dissolved in methyl alcohol it forms with iodide of methyl dimethylcadaverin. Is not toxic (according to Behring) in large doses. Causes inflammation and coagulation-necrosis (Scheurlen, Grawitz).

Putrescin ($C^4H^{12}N^2$). Found by Brieger in cadavers after the 4th day; also by Bocklisch in herring-brine.   Effects like those of cadaverin.

Saprin. Discovered by Brieger. Quite similar to cadaverin. Not toxic.

Mydalein. According to Brieger this appears in cadavers after the 7th day. Is quite toxic. A few milligrams injected beneath the skin of a rabbit produce copious secretions from the nose, mouth, lachrymal and intestinal glands, as well as dilatation of pupils and vessels, and rise of temperature, with final somnolence; 5 mgr. kill a cat.

Several other more or less toxic alkaloids, to which names have not yet been given by their discoverer, Brieger.   One of these causes violent diarrhœa and peristaltic motion.

B.   Ptomaines containing oxygen, whose bacteria are unknown, are connecting links between ptomaines and leucomaines met with alike in dead and living tissue.

Neurin ($C^5H^{12}N$)(OH).   Previously known in nerve tissue, but found also by Brieger in cadavers. Is very toxic; 4 mgr. kill a rabbit, causing severe peristalsis, profuse sweating, contraction of pupil and of spleen, and tetanic cramp.   Is antagonized by atropin.

Cholin ($C^5H^{15}NO^2$). Extracted by Stricker from bile. Is really both a leucomaine and a ptomaine. Is toxic in the same way as neurin, but much less so

Muscarin ($C^5H^{13}NO^2$).   First discovered in mushrooms by Schmiedeberg; later found by Brieger in putrefying dorse or torsk (fish). Has been synthetically produced by oxydizing cholin with nitric acid.   Is antidoted by atropin.

Gadinin ($C^7H^{16}NO^2$). Also extracted by Brieger from rotting torsk.

Two unnamed ptomaines, isolated by Pouchet, from the sewerage of manufactories where animal tissues are utilized.

Mydatoxin. Found by Brieger in putrefying human intestines and horseflesh. Slightly toxic.

Mydin. Same as above. Has marked reducing powers.   Not toxic.

Methylguanadin. From rotting horseflesh. Is toxic and produces tetanic spasms.

Another unnamed ptomaine, found by Brieger in the same material, has powers similar to those of curare

Mytilotoxin ($C^6H^{15}NO^2$). Isolated from the flesh of the limpet. Along with it Brieger found betain or oxycholin, which is not toxic; also a base which has marked sialogogue properties.

Peptotoxin. Discovered by Brieger in peptone, and found to have curarizing properties.

C. Ptomaines isolated only from pure cultures of known species of bacteria.—For these we are mainly indebted to Brieger, who also cultivated most of the organisms in media made with human flesh, in order to imitate our body chemistry as nearly as possible. ·

Typhotoxin. From cultures of typhoid bacilli.

Tetanin. From cultures of tetanus bacilli. Very toxic; producing first lethargy and apathy, then tonic and clonic spasms and death. Lately it is claimed that this has been extracted from the muscles of a patient with tetanus.

Tetanotoxin. Distilled from alkaline cultures of the above. Is weaker than tetanin, nevertheless strongly toxic.

Spasmotoxin. From same source, with similar properties.

A fourth toxic substance from this source produces also spasms, but especially causes copious secretion of tears and saliva. None of these four appear in the urine.

From cultures of the cholera spirillum *six* bases have been isolated—methylguanadin (*supra*), cholin, cadaverin, putrescin and two unnamed alkaloids.

To these I would add another class of

D. Ptomaines produced by certain species of bacteria, though as yet not necessarily identified solely with such species.

Tyrotoxicon, if produced exclusively outside the living organism. *Ammonia.*

Trimelhylamine ($CH_3)_3N$). Both produced by staphylococci growing on beef or veal; the latter produced especially by the s. albus, by micrococcus prodigiosus and by streptococcus pyogenes. Both these are irritating, the former particularly in its nascent state. The latter if not strictly a ptomaine is a descendant of one or closely allied to one, and at all events is injurious in the same way.

Toxalbumens.

Save that they are not, strictly speaking, ptomaines, these bodies are produced in the same way (by bacterial action) and produce disturbance in analogous manner.

A toxalbumen has been isolated by Brieger and Fraenkel (*Berl. klin. Woch*, 1890, Nos. 11 and 12) from cultures of Lœffler's diphtheria bacillus, which is an amorphous white powder, possessing fatal activities in small doses.

Other toxalbumens have been found by the same workers in cultures of the microbes of cholera, tetanus, typhoid, anthrax and of suppuration.

Leucomaines are alkaloidal substances produced during the life of the individual within his organs and tissues, by which they are entitled to rank as a class alongside of ptomaines. Their existence was first predicated by Gautier on purely theoretic or inductive grounds, which he then demonstrated to be correct by the discovery of a number of these substances. Roussy and Hugouneng first grouped them, about, as follows :

A. Betain-leucomaines.

Betain or oxyneurin ($C^5H^{11}NO^2$). First found by Scheibler in the red-beet. Liebreich found it in human urine and produced it synthetically by his different processes. Brieger found it in limpet's flesh. It appears to be identical with trimethyl glycocoll. Is not toxic.

B. Leucomaines of the uric-acid group.

Carnin ($C^7H^8N^4O^3$). Found in meat extract and brewer's yeast water.

Adenin ($C_5H_5N_3$). Met with in pancreas and spleen. With potassium hydrate forms water and "cyankali"

Guanin ($C^5H^5N^5O$). Common in both animal and vegetable world. Kerner found that the excretion of urea was proportional to the amount of it which he administered to rabbits.

Sarcin ($C^5H^4N^4O$). Found in living flesh. Isomeric and nearly identical with crystalline white powder.

Hypoxanthin.

Xanthin ($C_5H_4N_4O_2$). First found by Marcet in vesical calculi; then recognized in many organs.

Pseudoxanthin ($C^4H^5N^5O$). From muscles of swine.

C. Creatinin-leucomaines.

Creatinin $C^4H^7N^3O$). First produced by Liebig by treating creatin with hydrochloric acid; then recognized in urine. Has caustic properties. Ranke states that when introduced into the circulation it increases the irritability of peripheral nerves and produces muscle contractions.

Xantho creatinin ($C^5H^{10}N^4O$). Produces in small doses apathy, somnolence and nausea.

Cruso creatinin ($C^5H^8N^4O$). Resembles creatinin.

Amphi creatinin ($C^9H^{19}N^7O^4$). Same.

Two others isolated by Gautier, but not yet sufficiently studied.

D. *Leucomaines of special secretions.*

Viperin.
Echidnin.
Salamandrin.
Cobrain. } Poisonous secretions of reptiles and ser-
Crotalin. } pents. Their poisonous activities seem
Najin. } to be mitigated by the addition of potas-
Elaphin. } sium hydrate or sodium carbonate.
Cedrin.
Valdivin.

According to Calmels the primarily active agent in all of these albuminoid secretions is *methylcarbylamin*, which he believes to be produced in the cells of the gland in a nascent condition by the action of formic acid upon glycocoll. This methylcarbylamin seems to have frightfully poisonous properties, inhalations of it killing rabbits in a few seconds. Schwalbe also states that equally poisonous substances are secreted by certain fish in Chinese and Australian waters.

Protamin. Discovered by Miescher in semen.

Spermin. From same source.

E. *Leucomaines from particular organs.*

The eyes contain *neurin*, the brain *neurin* and *cholin*, the heart, lungs and blood the former. In fresh veal Guareschi and Mosso *methylhydantoin*. Wartz examined expired air and there found two bases, *ammonia* and another gaseous alkaloid not yet named. Brown-Sequard and Arsonval have also discovered a gaseous base in expired air, which produces in rabbits a lowering of respiration rate and an exaltation of pulse, contraction of the pupil, and fatal diarrhœa with colic. From the fresh spleens of swine Morelle extracted two bases, one of which kills frogs in five hours after complete paralysis of sensation. In urine a new base has been discovered by Pouchet. Bouchard has shown how those diseases which accompany or are caused by increase of putrefaction in the alimentary canal are characterized also by a greater excretion of leucomaines with the urine.

F. *Leucomaines which are produced in the bodies of patients and of diseased animals*

Pyocyanin belongs in more than one of these sections. Has been isolated from pure cultures of bacillus pyocyaneus, as well as from pus, blue sweat, etc. In contact with oxygen it changes to *pyoxanthose.*

Cadaverin and *putrescin* have been found in the urine and fæces of patients suffering from cystinuria; consequently we must probably consider cystinuria as due to intestinal mycosis.

Spermin, discovered by Schreiner in human semen, has been found in cultures of the cholera spirillum.

Phlogosin was separated by Leber from cultures of staphylococcus aureus. It causes inflammation when injected.

Dimethylamin has been found in sausage and in fish.

Triethylamin, *prophylamin*, *tyrotoxicon*, *etc.*, also deserve mention here, though it may be hard to assign them their exact positions in such a classification.[1]

As a positive demonstration of the formation of ptomaines by bacterial action there are perhaps no experiments more illustrative and convincing than those of Poehl. It is known that most at least of these alkaloids give color reactions with various salts, especially with those of iron.

Poehl mixed very small proportions (0.05 %) of perchloride of iron and ferro-cyanide of potassium with his nutrient media, and then cultivated various organisms thereon. In some cases slowly, in some rapidly, the color reaction appeared along the needle streak. Inasmuch as the resulting Berlin-blue, due to the reducing power possessed by the microbes, only forms in a slightly acid medium, the acid had sometimes to be added to previously alkaline or neutral gelatine jelly in which alone certain bacteria will grow. On the addition of nitric acid to cultures of cholera spirilla there developed beside the Berlin blue a reddish hue, which is also the case when these organisms grow on jelly free from either of these salts; this is probably identical with the skatol derivative found by Brieger in the urine of certain patients.

Poehl, by the way, observes that the Finkler-Prior bacillus needs a smaller proportion of acid to produce a similar reaction than Koch's spirillum, and recommends on these grounds the administration of oxidizing substances, like peroxide of hydrogen or permanganic acid, in order to check the formation of ptomaines and decompose those already formed —*Lancet*, October 30, 1886, p. 830.

But I must hasten along to consider the more exclusively surgical topics to which I desire to invite your attention throughout the remainder of this evening, and for the balance

[1] For further informaton the reader is advised to consult the excellent little monographs of Vaughan and A. M. Brown.

of this series of lectures. It is mainly to the matter of the surgical infectious diseases that this course is devoted, in other words to the mutual reactions of animal and vegetable cells.

Neelsen has divided the infectious diseases generally according to their bacteriological peculiarities, as follows:

1. General acute mycoses of the blood. (Anthrax, septicæmia of mice, etc.)

  a. Toxic (Septicæmia.)

  b. Intermittent. (Relapsing fever.)

2. Localized bacterial infections.

  a. Local, with secondary general poisoning. (Putrid fever, cholera, tetanus.)

  b. Local, with the general characteristics of inflammation, (Pneumonia, malignant œdema.)

  c. Local with necrobiotic tendencies. (Hospital gangrene, progressive necrosis.)

  d. Local, with pyogenic tendencies. (Suppuration.)

3 Mycoses of the blood with secondary local lesions. Measles, rötheln, scarlatina, variola, diphtheria, osteomyelitis, acute rheumatism, chicken-pox, cholera.

4. Mycoses with tissue proliferation; or the infectious granulomata.

This classification is logical providing it be quite correct, but it is questionable whether the diseases included in his third and fourth classes are in effect *mycoses*, and whether they are not due to some other parasitic form of life than the mycotic. Be this as it may those troubles which concern us at present are undoubtedly mycotic in origin, and we need only discuss some of their general phases before proceeding to special forms. And first of all and among the most important are:

CONDITIONS PREDISPOSING TO INFECTION.—These conditions must be studied on the part of the body infected and on the part of the organism which produces the infection. First of these it must be laid down as a general rule that the normal healthy tissues of the human body neither harbor infectious organisms nor favor their development when introduced. In other words, the highest type of tissue vitality

presupposes a condition which is inimical to the action of any
pathogenic bacterium.   Furthermore, that such organisms,
when introduced by accident into the circulating fluids of such
a typically healthy body, are quickly destroyed in the circula-
tion or in the tissues.   Certain organisms disappear from the
blood with remarkable rapidity, others are deposited in various
tissues or organs where they are quickly disposed of, while yet
others probably are excreted through some one of the various
emunctories.   When organisms disappear with such rapidity
from the blood, it must be because they are quickly destroyed.
Within the past year a number of papers have been published
with reference to the antiseptic properties possessed by blood
serum.   It is well known that the blood serum of different ani-
mals varies very much in this capability as well as in its action
with regard to different species. That the serum of rats' blood
possesses a high degree of resistance in this direction has long
been demonstrated by numerous laboratory experiments.   In-
deed so resistant is the common rat to most of the bacteria
which are pathogenic for the human species, that extensive
wounds can be inflicted upon them and not only no dressing
be applied, but every opportunity for septic infection afforded,
and still without the slightest apparent effect.   Numerous ex-
perimenters have injected into the venous circulation various
species of known organisms, and then have made or attempted
to make cultivations from the blood at intervals varying from
a few hours to a few days. It has been found that the rapidity
with which they disappeared from the blood varied with the
species employed, and according as it was or was not spore-
bearing.

According to Wyssokowitsch, when small quantities of spir-
illum tyrogenum, a non-pathogenic and non-spore-bearing
bacterium, were injected in the blood stream they were found
in greatly diminished numbers after five minutes, and had com-
pletely disappeared in seven.   In other cases spores were
rapidly deposited from the blood but retained their vitality for
several days. In the case of bacillus subtilis, a few were found
alive even after seventy-eight hours.   Apparently they were
deposited in the endothelial cells of the smaller vessels and
chiefly in the spleen.   The streptococci pyogenes, which do

not exert a pathogenic action when introduced into the blood of rabbits in small numbers, were much reduced in number after seven hours, and disappeared after fifty.

From Wyssokowitsch's researches it would appear that organisms which do not rapidly die are deposited like particles of pigment; thus anthrax bacilli, introduced in moderately small quantities into rabbits, were found to have disappeared from the blood after twenty-four hours, though they were present in large numbers in the spleen and liver. That organisms may be excreted by the kidneys is shown by various observations, and, as Cheyne points out, it affords a very plausible explanation for certain cases of pyelitis and bacteruria occurring in patients who have never had any instrument passed, and whose ureters and bladders are perfectly normal. The explanation being that these organisms had entered the blood in a living state, had been excreted by the kidneys, and had afterwards found a suitable culture medium in the urine and grew in the pelvis of the kidney, or in the bladder. Thus Ogston states that he has found micrococci in the urine of patients suffering from septicæmia, though these patients apparently had no disease of the urinary organs. This statement seems quite positive, although some have denied the excretion of bacteria by the kidneys, and claim that they only appear in the urine after rupture of blood vessels. So, too, in pyæmia and some other diseases, for example in Ribbert's experiment with aspergillus. There is a marked tendency for the organisms to locate in the kidney, which would seem to indicate some functional or anatomical attraction by which they are drawn thither. Ribbert in his investigations concerning the cocci of osteomyelitis in the blood, found that after twenty-four hours they could be demonstrated in all the organs by Gram's method, but that later they disappeared from all except the kidney. Experiments elsewhere alluded to in these remarks demonstrate their excretion by the mammary glands, and are of interest in that they show that the organisms which cause abscesses of these glands may be deposited there from the blood, although undoubtedly the majority of abscesses of the breast are caused by the inward spread of bacteria from the surface. The frequent occurrence of abscesses, especially

metastatic, in the parotid gland, after suppuration in other parts of the body, finds here also, perhaps, its most easy explanation. Passet has even stated that cocci were excreted through the conjunctiva in the case of mice and his statement is confirmed by Longard.

Embolism, as a factor in provoking suppuration.—Attention has already been called to the large part played by emboli in surgical inflammations and affections, since there is no limit inside the living body to which infected emboli cannot be transported. Ribbert, while studying the death of fungi in the body, met some beautiful demonstrations in this direction. On comparing his experiments with aspergilli with those made with mucor, he found that in the former case deposits were formed in various organs and muscles, while the spores of the latter gave rise to deposits in organs only, the muscles being not affected. Referring this discrepancy to the relative size of the spores, the mucor spores being much smaller and passing more easily through the capillaries, he endeavored to increase their size before their introduction into the blood, and so kept them for a short time in a nutrient fluid. In consequence, they swelled up and commenced to sprout, and then he injected them into the circulation, when he found no difference between his results. The inference to be drawn from these experiments is very obvious, showing that organisms will or will not obstruct the capillaries in proportion to their size. Working in the same direction Ribbert found that the staphylococci would pass through the circulation, to be arrested in the kidneys, but that if pyogenic cocci were attached to larger particles which could not pass the capillaries, he could only produce myocarditis and endocarditis. For this purpose he cultivated the microbes on potatoes, and in removing them for experiments secured a mixture of potato granules and bacteria. If the particles of potato were very fine, only myocarditis resulted; if they were grosser, endocarditis appeared as well. Bonome studied nine cases of gangrene of the lung in man, and discovered staphylococci in all of them. Injecting cultures of these organisms into the blood of rabbits, he failed to cause any gangrene there, but by mixing them with very fine pieces of elder pith, and then injecting this mixture in the jugular vein,

he produced numerous embolic lesions in the lungs, which led to coagulation necrosis and extensive gangrene, while injections of fragments of pith alone produced no effect. So also, Pawlowsky found that simultaneous injection of sterilized cinnabar and of cultivations of staphylococcus aureus produced abscesses in various organs and in fact typical pyæmia.

General depression of vitality.—This has been recognized as a cause predisposing to suppuration for centuries, long before its active causes were thought of. Thus by administering large doses of phosphorus for some time to animals, such changes are produced.

Thus too such conditions as those brought about by starvation, by overwork, by vitiated food, by exposure, possibly even by mental worry, will so far reduce the vulnerability of previously healthy tissues that they succumb much more readily to bacterial infection. Such experiments as those made by Arloing, Cornevin and Thomas, are more than suggestive. They, inoculated some frogs with rauschbrand, and placed them with others not inoculated in vessels containing water at 22 C. After fifteen to thirty hours the inoculated frogs died, and in their lymph-sacs the rauschbrand bacilli were still active and virulent, while the uninoculated frogs remained well. In contrast with this, other frogs inoculated with the same germs, but kept in cold water, were unaffected.

The experiments of Charrin and Roger (*Arch. de Physiol.*) show that great fatigue favors infection. Animals that have been violently exercised died in shorter time, after inoculation with symptomatic anthrax, than those that had not been fatigued.

Local depression of vitality.—This is a cause more easily recognized, at least, if not more generally met with. When a given part has been deprived for a time of its natural blood supply, bacteria grow in that part much more readily than if such supply had not been interfered with. Thus, according to Cornil, a septic nephritis is readily obtained by ligating the renal arteries for some hours, then removing the ligature and injecting pyogenic organisms in the blood. The experiments made by Chauveau, termed the *bistournage*, point unmistakably in the same direction. Heubner's experiments in artifi-

cially producing diphtheria are most demonstrative. He ligated
the vesical arteries for two hours, by which he produced in-
tense congestion and submucous œdema of the fundus of the
bladder, in consequence of which the epithelial cells died.
After removing the ligature and thus restoring the circulation,
there was copious exudate with coagulation necrosis. He
found that if at the same time that he restored the circulation
septic bacteria were injected into the blood, they accumulated
in large number at the seat of these changes, it being only
necessary that comparatively large numbers should be intro-
duced. It is also stated by Cornil that if a slight nephritis is
set up, either by cantharides or in some other way, and if then
pyogenic organisms are injected into the blood, a septic periton-
itis occurs.

Inflammation.—Obviously this is the most conspicuous illus-
tration of local depression of vitality, and has long been recog-
nized as preceding most every suppuration. Cheyne divides
inflammation into three stages, the first including all the phe-
nomena up to and including exudation; the second the substi-
tution of granulation tissue for that originally attacked, and
the third comprising the cessation of irritation and the changes
which lead to the formation of a scar. During the first stage
the natural vital activity of the part is suspended, and it is usu-
ally during this stage that organisms enter. It has been found
that pyogenic cocci are not as likely to settle and infect a part
which is acutely inflamed as in one where inflammation is less
severe, where, apparently, they most usually pass out of the
blood vessels. Thus Rinne, in experiments to be referred to
later, found that a violent inflammatory action did not pro-
duce a point of least resistance, but that a slighter injury or
disturbance, such as might be caused by the chemical pro-
ducts of bacteria, sufficiently weakened the part to enable the
organisms to grow in it. Thus acute osteomyelitis and local
tubercular disease much more often follow an injury of slighter
severity, and very seldom occur after an extensive lesion.
Fractures in consumptives are seldom if ever followed by local
tuberculosis, while slight sprain is frequently assigned as the
cause of such a process.

Cold.—A brief or long exposure to cold is so often men-

tioned as a cause for existing inflammations that it ceases to have much weight with the careful observer. It is only by careful experiment upon animals that its etiological importance can be determined. Lassar shaved a number of rabbits, and so long as he kept them at a suitable temperature they remained in good health. If plunged into ice cold water for from one to three minutes, and then carefully dried and warmed again, they almost always developed albuminuria with hyaline casts and with elevation of temperature. These animals often recovered to suffer in the same way again when similarly exposed. Microscopic examination showed that they had developed an interstitial nephritis. As more directly bearing upon our subject, the experiments of Grawitz on the relation of peritonitis to cold must here be mentioned. He shaved the abdomens of young animals, covered them for a short time with warm compresses, and then allowed a draught of ice cold air to play on the parts for twenty to forty minutes, and yet without noticeable effect.

Injury.—Injury acts in two ways. First by producing the first stage of inflammation, secondly by causing effusion of blood, and permitting an escape of any pyogenic cocci which may be there circulating, at a point where they may find a quiet medium suitable for their development. Prudden's studies of endocarditis have well shown the effect of injury, which is in large measure due to loss of resisting power of the endothelial and connective tissue cells. Since every wound must be followed at least by a conservative amount of inflammation it can be seen how operation wounds should be really included among injuries. Experimental work with symptomatic anthrax, which is only produced by bacilli acting in the tissues and not in the blood, affords ample illustration. If the bacilli of this disease are injected into the blood, the animals remain well and the bacilli soon disappear. But if immediately after their injection, a bruise be inflicted on some part of the body, by the aid of which the bacilli may escape from the vessels, soon the characteristic tumors form and the disease rapidly progresses to a fatal termination. Cheyne published the case of a drunkard in poor health suffering from albuminuria, who developed an abscess whenever and wherever he received a bruise. And every practitioner meets with analogous cases; in such instances the pyogenic cocci are alive in the blood, and the combination of lowered vitality, toxæmia and injury bring about the suppurative result.

EDITORIAL ARTICLES.

HORSLEY ON THE SURGERY OF THE CENTRAL NERVOUS SYSTEM.[1]

a. *Depressed fractures of the skull.*—The author urges in the most emphatic manner the necessity of trephining in every such case, whether or not accompanied by an external wound of the soft parts, or by immediate symptoms of gravity. He claims that especially in children who are tolerant of external injuries of this kind, the fracture will almost certainly bring with it, not only epilepsy, but also mental defect, persistent loss of memory and general deterioration. Trephining and the elevation of the bone to its normal position, with clearing the subdural space of blood and clots, should be the invariable practice in these cases.

b. *Laceration of the brain.* Not only in cases of compound fracture, recent or of long standing, but also in simple cases of laceration, Horsley advocates trephining, freely opening the dura, washing out clots, removing hopelessly bruised brain, the operation concluding by suture of the dura and replacement of the button of bone. He says that these measures may prevent or entirely relieve the remote and sometimes the immediate consequence of epileptic convulsions. He relates in illustration the case of a medical gentleman who sustained an extensive laceration of the brain, involving the frontal, parietal and temporal lobes. He was hemiplegic and partly unconscious for ten days, at the end of which time he suddenly, after exertion, developed most dangerous symptoms, became absolutely comatose, the respiration periodic, that is, Cheyne Stokes, etc. On trephining him freely and washing out the whole left dural sac free of blood and clots, he

[1]Abstract of the memoir presented before the Berlin International Medical Congress, September, 1890.—*British Medical Journal*, Dec. 6, 1890.

completely recovered, and is now practising his profession. Horsley considers that this was an instance of secondary hæmorrhage from a torn vessel.

Ordinary cerebral hæmorrhage, that is, from the lenticulostriate artery, constituting simple apoplexy. In these cases ligature of the common carotid artery should be performed, for the following reasons:

1. Present measures, for example, position, application of cold, bleeding, counter-irritation to the legs, etc., can in no wise be considered as in any way able to check the hæmorrhage from the injured vessel. Indeed, in appreciation of this view, most modern writers advise leaving the patient alone to take his chance.

2. The remote consequences, namely, permanent hemiplegia, even if death itself does not ensue, vary directly with the number of fibres torn through by the hæmorrhage; it is, therefore, absolutely incumbent upon us to, under all circumstances, stop the bleeding if possible.

3. This can be effected either by arrest of the carotid stream, or by ligature of, or pressure upon, the bleeding point

4. To effect the latter a dissection would have to be performed which would certainly produce more destruction than concomitant benefit.

5. On the other hand, compression, or better, ligature of the common carotid, not only arrests the flow of blood from the lenticulostriate artery, but in a few seconds also even the flow from the middle cerebral artery. See the *Brit. Med. Jour.*, March 2, 1889, page 457.

6. Aseptic ligature of the common carotid is a very simple procedure, and primary union can be ensured in a few days; the temporary paresis which has occasionally been noticed the author himself has never seen, and the occurrence of permanent hemiplegia, cerebral softening, etc., is only to be met with, so far as he is aware. in cases of septic operations. The dread of, and the importance ascribed to, ligature of the carotid are, therefore, quite fictitious, and ought not to be allowed to stand in the way of the suggested procedure.

Tumors. The author protests against the inordinate length of time

during which cases of brain tumor are subjected to treatment by drugs, so that when surgical relief is finally determined upon, the patient is quite unfit to undergo it. He alludes particularly to the use of iodide and bromide of potassium, and urges that unless very notable, not merely temporary improvement, is obvious after large doses have been given for six weeks, treatment by drugs should be abandoned, and exploratory operation resorted to.

Syphilitic cerebral gummata and pachymeningitis. As regards pachymeningitis, Horsley is certain that it has a great tendency to spread, even if the original placque be excised, while it is only moderated, not cured, by drugs. As to cerebral gumma, medicinal treatment in no wise cures, and only temporarily alleviates the trouble. For the cure of this condition, and of tuberculous nodules, excision offers the only chance for the patient.

Malignant and diffusedly growing tumors. Even where the necessity of early operation has not been recognized, these growths can be excised with temporary and remarkable benefit to the sufferer, but with, of course, an increasing risk of death from shock in proportion to the extent of the disease and the age of the patient. In such cases Horsley proposes that the growth be thoroughly explored, and if deemed irremovable that the wound should be closed. The effects are much better than might be anticipated. Not only are the intense headache and vomiting relieved, but a most interesting arrest of the optic neuritis occurs, a phenomenon which he has now observed repeatedly during the last five years, and which, in many cases, is a source of much amelioration to the patient from the consequent recovery of sight. Further, he has observed that the operation has conferred the additional benefit of notable prolongation of life. One case in particular, on whom he operated nearly two years ago for gliosarcoma of the cortex, is now enjoying very good health, and it seemed as if the effect of the interference was to check for a year the progress of the growth, for the symptoms steadily improved. A striking instance of the kind is that of a gentleman who presented the very rare condition of epileptic attacks in which the body rotated toward the left violently round the central axis, and, further, in whom the most distressing

attacks of dyspnœa occurred. Having made the diagnosis of a tumor of the middle cerebellar peduncle Horsley removed first one-half of the occipital bone, and later, at the patient's own request, the other half, with the effect of abolishing the respiratory attacks, which were very painful, the severe headache, and finally the turning convulsions, for a time. His life has been prolonged with much comfort nearly two years, the symptoms of pressure on the pyramidal tracts, which disappeared after the first operation, recently becoming marked again. Horsley has operated in six such cases with no death.

To sum up, the inference is that we should operate in all cases of tumor for the sake of the relief it affords, even should it be found during the operation that cure by removal is impossible.

Focal epilepsy. In all cases where an initial spasm of a segment or part of the body can be detected, an operation should be done. The foci of the representation of movement of individual segments of the body, as they exist in the cortex, are now fairly well known. The procedure to be adopted in these cases is as follows: Careful examination of the case, and the observation of attacks by trained nurses and attendants having been made possible, as will be the case in some cases of epilepsy, the formation of a positive opinion as to the seat of the epileptogenous disturbance, exploration of this spot should be undertaken, after a few months' trial with bromides, douches, etc. If no gross lesions are observable when the cortex is exposed, it should be stimulated with the induced current, preferably of a Du Bois-Reymond coil, furnished with one Daniell or chloride of silver cell, and with aseptic electrodes of platinum two millimetres apart. Careful observation will soon show movement of each segment.

The locality giving rise to the initial spasm should then be excised. Owing to the fact that the focus alone of the representation of one segment is thus removed, only slight and temporary paresis follows.

In a case operated upon by the author in 1885, and which he then regarded as hopeless, a most remarkable improvement and development has since taken place. Horsley does not think that a final answer can be given as to the freedom from epileptic attacks until each case has been observed for above five years, but if the attacks are

only mitigated in severity, and not absolutely cured, a notable relief is
afforded, of which the improvement in the mental condition is at once
the clearest evidence and the most desirable result.

Althetosis. Horsley regards this disease as a form of cortical dis-
charge, although he acknowledges that its pathology is as yet obscure.
He recently operated in an otherwise hopeless case, in which his col-
league, Dr. Beevor, having detected a successive invasion of segments
by the movement commencing in the thumb, had been led to the con-
clusion that the affection was of cortical origin. Horsley therefore re-
moved the focus for the representation of the movements of the
thumb, with the effect of arresting the movements for about two weeks.
They, however, returned, as the cortex around resumed its functional
activity. It is, therefore, evident that the whole representation of a
part must be removed, a course which the paralyzed state of the limb
fully warrants.

General operative dangers. The death rate for the operations per-
formed by Horsley had been 21%. These deaths he claims to have
been due entirely to the hopeless conditions of extensive injury and
septic meningitis, as well as the very advanced cases of cerebral tumor,
in which he has operated as a *dernier ressort*, but which ought to have
been treated surgically many months before. The best proof of this
is that the cause of death is invariably shock, and this not from loss of
blood or undue prolongation of the operation. The reproach of such
a death-rate will not be removed by refusal to operate, but by an early
and universal recognition of the futility of treatment by drugs.

In all other conditions the risk is nearly *nil*. The mode of union is
immediate in successful cases. Since his third case he has never
drained a case of primary operation, but has sutured the wound
closely.

Operative treatment of diseases of the spinal cord. Horsley has now
trephined the spine (opening the theca in six cases) nineteen times
with one death, which was from shock. He advises that in fracture of
the spine operation without delay should be resorted to in all cases
where displacement or crepitus indicates compression, and where ex-
tension directly after the injury clearly fails to reduce the deformity.

In caries of the spine, while he admits that operations in acute cases are likely to be unsuccessful, he thinks that where there is great pain, this might best be relieved and the abscess opened by trephining the spine posteriorly. In any case it does no harm, and he has seen cases advised to be let alone die in the excruciating agonies of acute compression, a state of things which is certainly a reproach.

As regards the value of the operation there can be no doubt. As an example, he cites a case in which the patient was cyanotic and obviously dying when the arches of the atlas and axis were removed with complete relief. Even where there was extensive concomitant tubercular disease in other viscera, he has seen patients actually improve after this operation.

SOME RECENT CRANIAL SURGERY.

Cranial surgery being still in a transition state, every contribution to its history is of particular interest as affording additional material, by the collation of which definite conclusions may be attained. Operations formerly tabooed on account of the extremely high mortality or great uncertainty attending them, are now admitted to the category of recognized procedures, while others have been rejected and still others are in process of development. The following contributions to cranial and intra-cranial surgery, collected from recent American medical journals, then form a useful part of the material upon which the establishment of the extent and limitations of the cerebral surgery of the future shall be founded.

Dr. C. B. Porter read before the Boston Society for Medical Observation three cases of fracture of the skull which he considered worthy of record, the first two from the severity and extent of the injury from which they recovered, and the third as showing a cure of bullet wound of the brain treated without operation under strictly antiseptic dressings, and all of them as showing the diminution of the danger of cranial surgery by antiseptic methods.

Case I. *Compound depressed fracture of the skull*.[1]—An unmarried laboring man, æt. 26, was injured presumably by a fast moving railroad train, sustaining a compound fracture of the right side of the skull. The wound of the soft parts extended from the right eyebrow, one inch from the middle line, in a curved direction over the frontal and parietal bones, about one and a half inches from the middle line back- ward to one and a half inches behind the ear, the flap thus outlined was torn off the skull down to a line with the zygoma and external meatus. Two-thirds of the orbital arch, the external angular process of the frontal bone and the roof of the orbit were attached to this flap, while a portion of the great wing of the sphenoid, the squamous por- tion of the temporal bone, and portions of the frontal and temporal bones were depressed and still other fragments had been lost entirely. The parts were cleansed and shaved, and under sublimate antisepsis, several small fragments of bone were removed, making it possible to elevate a large depressed area of the temporal; the orbital arch was then wired in place and the wound closed and dressed antiseptically. The patient did well, but four months later, the signs of necrosis being evident, an incision was made and several bits of bone and a large coal cinder removed. From this time the patient made an uninter- rupted progress to recovery.

Case II. *Compound depressed fracture of the skull*.—An unmar- ried teamster, æt. 20, as the result of a fall down an elevator well, sus- tained ten scalp wounds over the left parietal region and a depressed fracture of the skull $\frac{1}{2}$ by $1\frac{1}{8}$ inches, the fragment cracked through the middle, located to the right of the median line and just behind the coronal suture. Attempts to elevate the fragments failing, they were removed. The operation and the dressing were antiseptic, the patient's temperature never rose above 100.8° in spite of a slight discharge from a wound for a number of days, and the patient was discharged in thirty days.

Case III. *Gunshot fracture of the skull*.—An unmarried male clerk, æt. 19, sustained a self-inflicted 22 calibre pistol-shot wound in

[1]Fracture of the Skull. By C. B. Porter, M.D. (Boston). *Boston Medical and Surgical Journal*, April 10, 1890.

the forehead. The wound was cleansed and dressed antiseptically. During the first ten days he presented various cerebral symptoms from almost complete unconsciousness to right-sided paralysis and incoherence in language. From this time he made marked daily improvement, the paralyzed parts resumed their functions, intelligence returned, the discharge from the wound, always slight, ceased entirely, and twenty-four days from the injury he was discharged from the hospital, practically well.

Operation in compound fracture of the skull has been recognized as necessary in order to prevent the painful *sequelæ* of depression and irritation. The propriety of transforming a simple depressed fracture into a compound fracture in order to prevent these dangers has not yet been generally recognized by surgeons. Paralysis, epilepsy, loss of memory, pain in the head, deterioration of the mental faculties, the production of idiocy and insanity, and other consequences of cerebral compression are as likely to result from non-interference in simple as in compound fractures.

The three cases given are examples of the success attending the treatment of compound fractures of the skull and an indication of the impunity to be expected from the conversion of simple into compound fracture under antiseptic precautions. These facts add force to the opinion that antiseptic incision and elevation should be the rule in all compressed fractures of the skull with the removal in addition of irritating spiculæ of bone in cases of comminution.

Operation for epilepsy secondary to injury of the brain case, then, may now be considered as completely within the realm of operative surgery, since the operation in itself with due antiseptic precaution is practically free from danger. A case of this kind[2] is reported by Dr. Beach, of Boston.

CASE IV. *Operation for epilepsy following fracture of the skull.*— A girl, æt. 4, was kicked in the head by a horse, remaining unconscious for nearly a week, during which time some pieces of bone were re-

[2]Compound Comminuted Fracture of the Skull; Epilepsy for Five Years; Operation; Recovery By H. H. A. BEACH, M.D., (Boston). *Boston Medical and Surgical Journal,* April 3, 1890.

moved from the wound. The child made excellent progress until after a month convulsions due to suppuration at the wound appeared. After evacuation of the abscess, which was kept open for the next six months, she had no bad symptoms. Four years later she had the first of a series of epileptiform attacks which continued to recur about at monthly intervals. At the age of 9, she had a full epileptic seizure and from this time forth convulsive attacks appeared frequently.

Examination at the age of 12 showed a crucial cicatrix in the posterior temporal region, measuring five inches horizontally and four and a quarter vertically. A depression admitting the pulp of the index finger could be easily seen and felt at the point where the lines crossed. The line for the fissure of Rolando crossed the anterior portion of the wound area at a point midway between an inch and a quarter and an inch and a half in front of the sharp edge of bone that defined the depression. The fact of extensive suppuration having occurred made, notwithstanding, accurate localization clearly impossible. The continuance of her symptoms and the renewed frequency of the attacks compelled an affirmative decision as to the justifiability of an exploratory operation.

A semi-circular flap including the cicatrix was raised, disclosing a pulsating point in the center of the depression. An incision here opened into a web of cicatricial tissue containing in its meshes about a drachm of clear fluid; upon entering the tip of the little finger through the incision, brain pulsation could be felt where, before the flap had been removed, all seemed perfectly solid and firm; the finger could not be pushed in any direction owing to the very firm adhesions of the cicatrix to the bony border of the opening. Assuming that the fluid was cystic and located in the dura, whether residual from the old abscess or not, that its shape was flattened from the great pressure to which it had been subjected through cicatricial contraction, and that the irritation caused by its presence might have produced the epilepsy, it seemed desirable nevertheless to search further for a possible spicula of bone or other irritating body. The collapsed cyst then having been dissected from the bone, a finger was swept completely around the internal surface of the skull for a distance of one half an inch from the

border of the opening, detaching the adhesion and dura—which could not be separated—from the bone. A sharp spicula of bone was found projecting one-third of an inch from the anterior border of the opening, and it was removed, with the bone to which it was attached, with the bone forceps.

The brain had now retreated from the opening sufficiently to show a mass of firm cicatricial tissue projecting from the surface. This was carefully dissected from the brain, and where it had become consolidated with the cortex enough of the latter was removed to leave a soft velvety surface as nearly like that of the healthy brain as possible. The hæmorrhage, though considerable, was not troublesome. The wound was closed and dressed antiseptically. The patient made an uninterrupted progress to recovery, union by first intention having occurred.

At the date of publication, eight months after the operation, the patient was well and had suffered no recurrence of the convulsions.

Dr. Reeve, of Dayton, Ohio, has reported the following case[3] of operation for epilepsy secondary to fracture of the skull that resembles the foregoing in many respects:

CASE V. *Operation for epilepsy following fracture of the skull.*— A youth, æt. 18, had received, nine years previously, a compound comminuted fracture of the right parietal bone with injury and exudation of brain substance, and in dressing the wound, six or eight pieces of bone were removed, one piece as large as a quarter of a dollar being felt deep in the brain and extracted, while brain substance to the extent of two or three teaspoonfuls was lost. Recovery was retarded by a hernia cerebri which recovered under treatment by pressure.

After two years passed in good health, epileptic convulsions appeared, separated by gradually shortening intervals, until seven years later, but a few days elapsed between them. At this time operation was determined upon. Examination showed, about the middle of the right side of the head, an oblong space with very irregular edges, where bone was entirely absent, measuring two and a half by two inches, and so much depressed below the level that the thumb would lie well in it.

[3]Case of Traumatic Epilepsy; Operation; Recovery. By J. C. REEVE, M.D., (Dayton, Ohio). *New York Medical Journal*, March 29. 1890.

With antiseptic precautions, a flap including the depression was dissected up easily from the bone but with great difficulty from the scar tissue filling the hiatus. Careful search revealed no projections into the brain and without separating the scar tissue from the brain on account of the abundant hæmorrhage, and the wound was closed. The patient made a good recovery, and after a year and a half has had no recurrence of the epilepsy.

Epilepsy was again the cause of a similar operation[4] by Dr. Keen, at the Jefferson Medical College Hospital. In this case, however, the source of the convulsive affection—not indicated by an external cicatrix—was traced directly to its origin in the cerebral cortex and the operative procedure was directed toward that point.

CASE V. *Treatment of local epilepsy by excision of the hand centre from the cerebral cortex.*—A boy, æt. 6, when fourteen months old, fell a distance of ten or twelve feet, but sustained no obvious injuries. He soon began to develop great irritability and bad temper, and after a few months began to suffer epileptic convulsions, occurring from three to six times a day and continuing during the following four years.

Observation showed that the convulsive movements began with and centered about the right hand and arm. Careful search discovered no scar or other external mark indicating this or any other source for the trouble. Accordingly it was decided to trephine over the motor center for the hand and excise it. The location of the centres having been estimated by means of Wilson's cyrtometer, the scalp was elevated, a button of bone removed with the trephine and the right motor region exposed. The hand center having been definitely located on the cortex by the battery, Dr. Keen excised it. The hæmorrhage having been arrested and suitable drainage provided, most of the bone was reimplanted and the wound closed and dressed antiseptically. Speedy recovery took place and the child was taken home three weeks later.

After eleven months, Dr. Keen reports the patient's condition much

[4]Removal of the Hand-Centre from the Cortex Cerebri in a Case of Local Epilepsy. By W. W. KEEN, M. D., (Philadelphia). *Medical News*, April 12, and November 29, 1890.

improved, although he is not completely cured. The fits have been far less frequent, his intelligence has developed notably and his disposition has undergone marked improvement.

A case[5] of cerebral trouble secondary to a fracture of the skull, and resembling in some respects Cases IV and V was operated upon by Dr. Poore, at St. Mary's Free Hospital for Children, in New York, as follows:

CASE VII. *Operation for hemiplegia following fracture of the skull.*—A girl, æt. 3, at eleven months sustained a depressed fracture of the right side of the skull, which had not been treated. This accident was followed by mental feebleness, exceeding irritability of disposition and paralysis of the left upper extremity in which the left lower extremity also was partially involved. Examination of the head discovered over the right parietal bone a depression, easily admitting the end of the finger and presenting at the bottom a feeling of resistance as if the finger came upon bone, and after the hair had been removed, pulsation was detected over the point of injury.

A scalp flap was dissected up with some difficulty immediately over the point of injury and the opening in the skull was found to be filled with fibrous tissue enclosing a cyst-like cavity from which about a half a drachm of clear fluid was drawn off. No depressed bone was found, and there were no projections into the brain cavity. On account of symptoms of collapse, the exploration was necessarily hasty; the wound was duly closed and dressed antiseptically.

The wound healed kindly and the paralysis of the left extremities immediately began to improve, and nine months later the troubles for which she was treated were almost entirely relieved. They had, however, been replaced by other cerebral changes as manifested by Jacksonian epilepsy.

A suggestive case[6] of cerebral abscess was read before the Society

[5]A Case of Traumatic Hemiplegia; Operation. By CHARLES T. POORE, M.D., (New York). *New York Medical Journal,* February 1, 1890.

[6]A Case of Cerebral Abscess of the Brain, with Some Remarks upon Its Relation to Contusion. By CHARLES PHELPS, M.D., (New York). *New York Medical Journal,* March 29, 1890.

of the Alumni of Bellevue Hospital, by Dr. Charles Phelps, substantially as follows:

CASE VIII.   *Cerebral abscess of the brain.*—A man, æt. 34, sustained a compound comminuted depressed fracture of the skull just above the right ear. the dura mater being uninjured.   The fragments were elevated and the wound properly treated, healing without difficulty.   Less than a month later, however, he began to exhibit alarming cerebral symptoms, suffering severe frontal headache, followed by delirium, somnolence and hemiplegia.   On the following day he had almost complete paralysis and anæsthesia of the left side, which, after twenty-four hours more, became more pronounced and were accompanied by involuntary and unconscious evacuations from the bladder and rectum.

The trouble having been diagnosed as either cerebral abscess or rapidly extending softening, the wound was reopened.   Incision of the dura mater revealed no pus, but penetration of the brain substance by a probe produced a reddish, purulent discharge.   The cavity, thus opened; was washed out and drainage provided and the wound closed. The patient bore the operation badly, respiration ceasing twice, recurring the second time only after tracheotomy.   He remained unconscious, however, aud died sixteen hours later.

The autopsy revealed an extensive fracture extending into the base of the skull, but no point upon the external surface of the brain showed any trace of injury or degeneration.   The abscess cavity was identified in the right hemisphere and found to be surrounded by quite an extensive area of softening, but it presented no connection with the exterior except the communication accidentally made with the probe during the operation.

There being no injury either of the membranes nor of the superficial cerebral matter, and healthy brain tissue intervening between the altered tissue and the external injury, it follows that the original injury did not proceed from direct violence.   The law of dependence of cerebral abscess upon traumatism being accepted there seems to be no other explanation of the condition in this case than contusion by contre-coup.

In three cases[7] reported to the Boston Society for Medical Improvement, Dr. Putnam makes a practical contribution to the study of cerebral localization.   In brief they are as follow:

CASE IX.   *Sarcomatous tumor of the brain.*—A man, æt. 39, with no signs or history of constitutional disease, presented intense and incessant pains centering in the posterior part of the right temporal region.   On one occasion he experienced a seizure, characterized by partial unconsciousness; the left arm was abducted at the shoulder, the elbow being flexed, and slight but regular convulsive movements caus ing abduction of the arm and possibly slight elevation of the front of the shoulder, were presented.   The left wrist and fingers twitched slightly at the same time, the body being so strongly inclined to that side that it could be straightened only with great effort.   The left knee-jerk was rather lively and there was no ankle-clonus.   The convulsive movements gradually subsided in course of a minute or two, but the patient remained in a stupid condition for some time longer, and as much as five minutes later, the left knee-jerk was still greater than the right.   An hour or so later, he was still in a confused state, not know· ing where he was, but able to express himself intelligibly.

He suffered from double optic neuritis, very much more intense on the side of the tumor—the right. The left leg and arm became slightly weaker than the right. The headache persisted and the mental dullness increased until, six months after the beginning of the disease, he died.

The autopsy showed the right frontal lobe bulging forward, the projection being especially prominent at the middle of the second frontal convolution, at a spot lying between one and a half and two and a half inches in advance of the pre-frontal sulcus.   The surface of the right hemisphere was found pushed across the median line and slightly adherent to that of the left.   The optic tracts were excessively flattened by pressure.   A section through the right frontal lobe laid bare a grayish, almost translucent mass, mottled and streaked with red, with borders which were well-defined anteriorly, less so posteriorly and of slightly firmer consistency than the surrounding substance.   This oc-

[7]Three Cases of Cerebral Tumor, with Autopsy.   By JAMES J. PUTNAM, M.D., (Boston).   *Boston Medical and Surgical Journal,* April 10, 1890.

cupied the entire width of the middle frontal convolution and extended from about the middle of the external convex surface of the frontal lobe back to the pre-frontal sulcus, also encroaching somewhat on the superior and interior frontal convolutions subcortically. The tumor measured two and a quarter by one and three-quarter inches, the longest diameter following the length of the convolution.

Knowing that movements at the shoulder are represented in the upper and anterior portion of the motor area and recognizing that the far greater degree of optic neuritis of the right side was, on the whole, confirmatory of the diagnosis of a unilateral tumor, the growth would have been discovered had the skull been opened before death. But as but one characteristic convulsion had occurred and as the other signs were only of moderate localizing value, the operation did not seem justifiable. Moreover it is very doubtful if the tumor could have been removed successfully on account of its size and the difficulty of defining its limits.

An interesting point in connection with the case is that it contradicts the opinion that the second frontal convolution contains facial centers, the face not being involved to any noticeable degree in the convulsion or paralysis.

CASE X. *Two Sarcomatous Tumors of the Brain.*—A man, æt. 58, presenting no signs nor history of constitutional disease, was seized with a violent general convulsion, afterwards considered to be due to the invasion of the membranes of the temporal lobe by the new growth. This was followed by the appearance of aphasia, partly sensory and partly motor, with alexia. Later epileptiform seizures appeared, consisting in tremor of the right arm and leg, and right hemi paralysis of shifting intensity developed, terminating in complete paralysis with contracture. About a month before death, well-marked double optic neuritis was found, but the examination was attended by so many difficulties that it could not be determined on which side it was the more intense. For a number of weeks before his death he lay in coma, scarcely living, the respiration being for a long time excessively feeble and shallow, and occasionally of Cheyne-Stokes character, while during the three days before death the temperature ran up rapidly from 97.5° to 103° F.

On autopsy the entire second left temporal convolution was filled with a softened disintegrated yellowish tissue to within about 3 cm. of its anterior end. The posterior portion of the left parietal lobe was also found to contain a subcortical mass of the new growth of the size of a horse-chestnut, and was extensively softened, mainly from excessive œdema. The convolutions of the Rolandic region, notwithstanding the indications of the convulsive movements of the extremities, were normal.

CASE XI. *Tumor of the brain. Unsuccessful operation due to misleading localizing symptoms* —A man, æt. 51, with no signs or history of constitutional disease. was affected with short attacks of arrest of power of speech without complete loss of consciousness or of power of expression in writing or of comprehension of simple speech or written signs, but preceded by trifling tremor of right hand. He developed a permanent slight hesitancy of speech, with slight paraphasia. Occasional general convulsions would appear without aura. Severe frontal and occipital headache persisted, and with it developed general mental dullness obscuring the more special symptoms.

Five months from the appearance of the earlier symptoms, the first symptom beside the aphasia that could be called localizing occurred, consisting of slight convulsive action of the flexors of the right hand, with tendency to contracture, and a slight similar action of the upper eyelids. These attacks were repeated frequently and in time paresis of the extensors of the right hand began to develop. Optic neuritis was present, about equal in both eyes.

In view of the fact that the patient's first symptom had been a marked loss of speech preceding such general signs as headache, that there had been a recurrent spasm of the hand and fingers, and that no symptoms had occurred which could be confidently interpreted as pointing to any lesion of the parts posterior to the central convolutions, such as loss of muscular or cutaneous sensibility, sensory aphasia, or special disorders of vision—it was concluded that the tumor, which was so evidently present, was in the anterior lobe opposite the lower part of the central convolution. A lesion of the central frontal convolutions and of the motor pyramid tract was excluded by the fact that

marked paralysis was absent in spite of the severity of the pressure as indicated by other symptoms.

In accordance with this diagnosis, Dr. Beach operated[8] with careful antiseptic precautions.   Elevating a scalp flap, an opening through the skull, one by two inches, was made with the trephine and bone forceps. The dura having been cut, the bulging brain substance was carefully explored with the scalpel to the depth of an inch, producing no undue hæmorrhage, serum nor pus.   The four surfaces of the wound were then carefully explored with the finger but nothing abnormal could be discovered except an unusual· toughness and thickness of the dura. The wound was closed; the bone not being replaced on account of the cerebral projection.   While he reacted well from the operation, he continued to sink and died on the second day thereafter.

The autopsy discovered the tumor at the same level at which it had been sought, but considerably behind the motor area, its posterior edge being limited by the posterior ascending branch of the fissure of Sylvius.   The anterior boundary was formed by a small sulcus, leaving the fissure of Sylvius a little behind the anterior extremity of the inter-parietal fissure, which ran down parallel to the fissure of Rolando and was continued by a sulcus opening into the Sylvian fissure.   The motor convolutions and the frontal convolutions were perfectly healthy except as regards the effects of pressure and disturbed circulation. The optic tracts were strongly compressed.

These three cases exhibit clearly the difficulties and uncertainties of cerebral localization and the danger of operation where localization has been correct.   They do not prove a discouragement to operation, however, for the impunity with which the skull may be opened under proper antiseptic surroundings, as shown by the earlier cases, may safely be said to render exploratory trephining incumbent upon the surgeon in every case where there is a reasonable possibility of bene-fiting the patient.   JAMES E. PILCHER.

[8]Operation in a Case of Cerebral Tumor. By H. H. A. BEACH, M.D., (Boston). *Boston Medical and Surgical Journal,* April 10, 1890.

INDEX OF SURGICAL PROGRESS.

CHEST AND ABDOMEN.

I. Actinomycosis of the Chest and Lung; Operative Treatment. By Dr. NIKOLAI A. VELIAMINOFF (St. Petersburg). At a recent meeting of the St. Petersburg Medical Society, the author has communicated the following rare and interesting case: A very poor working woman, æt. 60, with paresis of her left limbs of 8 years' standing, sought his advice on account of a moderately painful swelling of her left mamma, which had appeared 3 weeks previously. The swelling proved to be a large, red, retro-mammary abscess of subacute ("semi-cold") variety. It was found, further, that the patient was suffering from diffuse chronic bronchitis, with a very abundant offensive discharge of a dark color. The woman was brought under the influence of chloroform, and the abscess opened by a free incision along the upper and outer boundary of the breast. A great quantity of fetid pus escaped, the patient simultaneously coughing out similar purulent matter. While removing granulations from the cavity, the author noticed that a subjacent rib, near the junction with its cartilage, was lying bare, and that beneath the area there were present several fistulous openings. The piece of the rib with cartilage having been excised, a small purulent cavity in the lung itself became exposed Any slightest touching of the area induced attacks of cough with expectoration The pulmonary cavity was thoroughly scraped out with a sharp spoon (after which the cough ceased), disinfected, plugged with antiseptic gauze, and the external wound also plugged and supplied with a drainage-tube. The temperature after the operation never rose above 38° C., cough disappearing completely in two days or so. On changing the dressing, several grain-like bodies were discovered in the wound which, under the microscope, proved to be typical actinomycotic fungi. A

month later the patient was discharged in a good general state, but with multiple fistulæ at the site of the operation. When shown to the Society $1\frac{1}{2}$ years after the operation, she was feeling and looking quite well, her lungs being apparently entirely sound. The fistules, however, still remained; there was also present slight swelling about the sternum and the rib operated upon.—*Vratch*, No. 42, 1890, p. 967.

<div align="right">VALERIUS IDELSON (Berne).</div>

II. Recovery From Acute Diffuse Suppurative Peritonitis by Laparotomy. By Mr. HAWKINS-AMBLER and Mr. LAWFORD KNAGGS. The authors report to the Clinical Society of London a case of suppurative peritonitis, occurring in a boy, æt. 9, and giving all the symptoms of intestinal obstruction. The obstruction was due to adhesions which so held the gut in Douglas' pouch as to kink it. Operation was done on the second day after the development of the symptoms. The adhesions were broken down by the fingers, the pus evacuated and drainage tubes inserted, the peritoneum not being washed. The authors lay stress on this point, as they believe any attempt at washing would have produced a fatal result.— *Brit. Med. Jour.*, May 15, 1890.

III. A Case of Fæcal Extravasation into the Peritoneal Cavity; Thorough Washing of the Peritoneum; Recovery. By HARRISON CRIPPS, F.R.C.S. (London). Mr. Cripps reports a case of carcinoma of the rectum, in a woman, æt. 52, for which he did an inguinal colotomy, opening the bowel on the second day after the operation. On the fifth day, during a fit of coughing, the sutures gave way and the bowel fell back, allowing fæces to flow into the abdominal cavity. This was soon followed by much pain and the symptoms of collapse. Five hours later the wound was opened, the bowel raised into the wound, the entire peritoneal cavity flushed until the returning water came away clean, and a glass drainage-tube was then introduced. No anæsthetic was used. The pain entirely ceased immediately after the washing. She did not recover entirely from the shock for nearly 3 days. After that time she went on to a complete recovery. Cripps calls attention to the severe pain produced

by the presence of fæces in the peritoneal cavity, the immediate cessation of it on cleansing the parts, and the non development of seconday peritonitis.—*Brit. Med. Jour.*, March 1, 1890.

H. BEECKMAN DELATOUR (Brooklyn).

IV. Case of Enormous Acute Abscess of the Abdominal Wall; Recovery. By Dr. LEONTY P. ALEXANDROFF (Moscow, Russia). The writer records the following exceedingly rare case: A previously generally healthy little girl of 3 years and 7 months, of a healthy family, had had a sharp attack of acute colitis. About a month after a complete recovery from the disease there appeared a gradually increasing enlargement of the abdomen, accompanied by high fever, semi-conscious state (of 4 days' duration), and vomiting. On the eleventh day of the affection, the navel (which became very prominent) burst, and an enormous quantity of pus escaped. When admitted to St. Olga's Hospital for Children, on the twenty-first day (of the disease), the child was extremely emaciated and exhausted. In the umbilical region there was situated a fistula, encircled with flabby fungating granulations, and profusely discharging a thin, greenish pus. The recti abdominis were sharply delineated, while the abdomen was neither distended, nor markedly tender on palpation. The child's stools remained regular all through. On examination (under chloroform), by means of a thick and long silver probe, there was discovered a cavity, lying between the anterior abdominal wall and parietal layer of the peritoneum, and occupying the whole region from the diaphragm down to the navel on the median line, and to a point in two fingers' breadth above the anterior superior iliac spine on either side. The abscess, seemingly, extended far backward beneath the diaphragm, and encroached the axillary lines in lateral direction. The treatment consisted in opening the abscess with two vertical incisions, each 4 cm. long, at the level of the navel and slightly below the costal arches. The cavity was thoroughly washed out with a boracic acid solution and supplied with drainage-tubes, the remaining portions of the wounds being closed with silk. The after-course was most satisfactory. Fever rapidly subsided, the discharge quickly decreased, the

wou1.ds healing *per primam*.   On the thirty-fourth day after operation,
the child left well, having gained in weight 2,330 grammes.—
Bolnitchnaia Gazeta Botkina, Nos. 16 and 17, 1890, p. 376.

                                          VALERIUS IDELSON (Berne).

V.   Contribution to the Surgery of the Stomach.   By
PROF. G. F. NOVARO (Siena, Italy),   The author after giving a historical sketch of the surgery of the stomach reports, *in extenso*, 14 cases
in which operative procedure was necessary on account of stenosis of
the pylorus.   Among these are 13 cases of his own and one of his assistant.   He performed 3 times pylorectomy, 5 times pyloroplasty and
6 times gastro-enterostomy (according to Wölfler's method). In 1 case
of carcinoma he performed resection with success.   In 4 other cases
of carcinoma he performed gastro-enterostomy. In all other cases cicatricial stenosis was the indication for operative interference.   Of the
5 patients afflicted with carcinoma 3 were improved and 2 died.   Of
those patients which were operated on for cicatricial stenosis, 9 in
number, 7 were cured and only 2 died.   Six of these remained permanently well, and 1 of them died from the consequence of a subsequent operation.   The author considers in this work also the causes of
stenosis of the pylorus and the different methods of operation.

Among the causes of stenosis the writer mentions: Neoplasms,
cicatricial stenosis following the action of caustic fluids, round ulcer,
cicatrices in tuberculous ulcers of the duodenum.   As to frequency,
neoplasms, especially carcinoma, take the first rank;   then follow cicatricial stenosis from the action of caustic fluids, round ulcer and,
finally, tuberculous ulcers of the duodenum.   Novaro, also, calls attention to circumscribed peritonitis and chronic gastritis as causes of pyloric stenosis. As rare causes of stenosis he enumerates: Syphilitic gummata, tumors of the gall-bladder, tumors of the periportal lymphatic
glands and pancreas.   He refers, also, to the rare cases of congenital
stenosis.

Not considering especially the procedures which were used in certain
isolated cases, as that of Bernay's (gastrotomy with subsequent curetting of the tumor), or Ceccarelli's method (incision of the neoplastic

structure, causing the stenosis from within—a form of pylorotomy), and Hahn's procedure (intubation), we possess, at present, 4 different methods of operation, *viz.*, digital dilatation (Loreta's method), pylorectomy, pyloroplasty and gastro-enterostomy. Digital dilatation, if practicable, is certainly the simplest procedure. The great mortality (40%) does not recommend this method, but the author thinks if this mode of interference will be properly limited to those cases in which the stenosis depends upon hypertrophy of the muscular layer or spasms of the latter in the pyloric region, its results are sure to improve.

Pylorectomy is, without doubt, the most radical procedure. The development of stenosis, after the performance of this operation, has been observed only in a few cases. That the results are often unfavorable is due to the fact that this operation is performed more frequently than indicated. The operation should only be done in those cases of carcinoma in which the tumor encroaches not too much upon the stomach, little or not at all upon the duodenum, and where it forms no adhesions with the pancreas, the liver or colon. Moreover, in the cases where this operation is indicated one should be able to lift the tumor out of the abdominal cavity and one should not find nodules in the walls of the stomach or on the surface of the liver, nor enlarged and indurated glands in the proximate surroundings. The use of this operative measure in stenosis caused by simple gastric ulcer should be limited to those cases in which the ulcer is not yet in the healing stage, or where it (the ulcer) is of suspicious character (carcinoma), or where there exists simultaneously a polypous degeneration of the mucous membrane of the pylorus. Pylorectomy may also be employed in cases of callous cicatrix, where fibrous cancer is suspected. Even in the above enumerated cases, except in carcinomatous ulcers and callous cicatrices, partial resection may be sufficient.

Resection is always more difficult and more tedious than pyloroplasty according to Heincke—Mikulicz's method. This latter has been employed since 1886, in 11 cases and yielded only 2 deaths (18% mortality). It may be practiced successfully in most cases of cicatricial stenosis, either alone or combined with partial resection. If stenosis

of the pylorus or the duodenum be in question, and where the parts in-
volved are inaccessible on account of the adhesions, then gastro-enter-
ostomy must be resorted to.   This latter is not entirely without dan-
ger, but may, in cicatricial stenosis, bring about a cure, and in malig-
nant neoplasms will afford considerable relief to the patient.

The author gives a review of 55 cases of gastro enterostomy, in
which Wolfler's or Hacker's modification was used, with 24 deaths
(43.63% mortality).   Among these cases were 12 of cicatricial steno
sis which were operated on by Wolfler's method only, with 2 deaths
(16.66% mortality).   The same procedure used in carcinoma yielded a
mortality of about 51%.   The writer (on page 19 of his work) refers
also to the method recommended by Vogt, whtch consists in severing
the continuity of the small intestine, fixation of the efferent part to the
stomach and attaching of the afferent part to the efferent somewhat
below its fixation to the stomach.   He thinks that this procedure is
rather complicated and prolongs the duration of the operation

At the end of his work, which comprises 73 pages, Prof. Novaro ex-
presses his thanks to Prof. Cantieri and his own assistants for the sup-
port which they gave him in this work.—*Estratto dagli Atti Della R.
Accademia dei Fisiocritici*, Serie iv., vol., ii, 1890.

A. PICK (Boston.)

VI.   A Proposal for the Radical Cure of Inguinal Hernia.
By DR. GUSTAV KOLISCHER.   The well attested fact at the present day,
of comparatively frequent occurrence of relapse following radical opera-
tions for the cure of hernia are to be accounted for, not only by the pe-
culiar predisposition which results from the passage of the spermatic
cord through the inguinal canal, but by the giving way of the cicatri-
cial tissue to the intra-abdominal pressure.   The author proposes to
overcome the last named by the following procedure :   After the per-
formance of the radical operation in the usual manner, without sutur-
ing of the pillars, he makes an arched-shaped incision along the lower
edge of the symphisis pubis, which incision passes through the perios-
teum and is prolonged to the insertion of the adductors.   The pyra-
midalis muscle is dissected from the symphisis together with the perios-

teum and is then loosened, with its sheath, from the rectus muscle. A flap of muscle is thus obtained which is turned up over the external ring and fixed by sutures.   The author has made trial of the opera-tion only upon the cadaver.—*Cenbl. f. Chirg.*, 1890, No. 45.

<div align="right">GEO. R. FOWLER (Brooklyn).</div>

VII.   On the Significance of the Howship-Romberg As-sociation of Symptoms in Incarcerated Obturator Hernia.

By Prof. KRONLEIN (Zurich).   In the 140 years since the discovery and first description of hernia obturatoria by Arnaud de Rousil, there has been a steady increase in the number of recognized and success fully operated cases of such incarceration.   Still Krönlein finds that the diagnostic points are often fancifully stated.   From 1870 to 1884 he did not meet a case, but in the next five years he saw 4.   Of these only 2 were operated, as the other 2 were already moribund.   As an indication of the relative frequency of this form, he stated that during the same five years he did a total of 138 operations for hernia.

The two operated cases have been previously described by Mun-zinger and Brunner.   They each resulted fatally, one in a few hours from collapse, the other from perforation.

The symptoms are those of ileus, together with pain in the thigh, radiating from Poupart's ligament to the knee, excessive painfulness from pressure over the corresponding regio pectinea, and still more behind the adductors in the direction of the oval foramen, in one case some swelling of the leg and slight prominence of the regio pec-tinea, pain on motion in the hip.

But he gives full details of a fifth observation, in which all these symptoms (on the left side) were present in a boy of 12 years, and yet the cause was an intra-peritoneal pelvic exudation instead of an ob-turator hernia.   In reality, however, no case of such hernia has ever been observed in childhood, this form being particularly the hernia of old age.   The double operation was performed three days after the acute onset of the trouble.   On opening below Poupart's ligament to the obturator canal the only change found was a distension of the ob-turator vein.   Then on performing laparotomy (opening along the ex-

ternal border of the left rectus muscle) a slightly encapsulated collec-
tion of pus was found low down.   No trouble on the right side, and in
fact no cause discovered.   Rapid recovery.—*Bruns' Beitrage zur.
klin. Chirg.*, 1890, Bd. vi., heft i.

WM. BROWNING (Brooklyn).

VIII.   Prolapse of the Rectum.   By Dr. VERNEUIL (Paris)
The author proposes to overcome this condition by a new
procedure which has for its object the elevation and attach-
ment of the rectum to the region of the coccyx, rather than a
narrowing of the lower portion of the bowel.   The operation is per-
formed as follows: After reposition of the prolapsed portion, with the
patient in the lithotomy position, two incisions, from 4 to 5 cm. in
length, are made, at right angles to the long axis of the anus, from the
opening of the latter in an outward direction.   From the point where
these incisions terminate, two other incisions pass to meet each other
at the point of the coccyx, thus including an equilateral triangle with
its base placed anteriorly.   This triangular flap is loosened from be-
hind forward, and left temporarily attached to the tissues surrounding
the anus, comprehending in its thickness the skin, the subcutaneous
cellular tissue, together with the fibers of the external sphincter.   With
this flap strongly retracted by means of blunt retractors, the posterior
wall of the rectum is loosened for a breadth of from 5 to 6 cm., and to
a height corresponding to the distance from the anus to the tip of the
coccyx.   Four threads are now passed transversely through the pos-
terior rectal wall, parallel with each other, and not including the rectal
mucous membrane.   The upper one of these sutures is placed at a
point in close relation to the point of the coccyx, while the lower one
is removed about 15 mm. from the anus.   By means of a needle with
an eye at the point, which is passed through the skin from without, the
threads are drawn through the points of emergence of their respective
ends, being selected at about 4 cm. from the median lines at either
side.   The upper suture should be on a level with the articulation be-
tween the first bone of the coccyx and the sacrum, and the lower at
about the point of the coccyx; the intervening sutures are placed

about equi distant between. These are now secured upon one side in such a manner that the first and second, and the third and fourth are tied together; rolls of iodoform gauze being placed beneath the loops to prevent the latter from being buried with the skin, strong traction upon these secures the rectum in its new position, and the other ends of the threads are similarly secured. The triangular-shaped flap is now removed, the muco cutaneous anal margin being preserved, and after inserting a drainage-tube, the wound is closed by sutures.—*Bull. et Mèm. de la Soc. de Chrg. de Paris*, T. xv., p. 754.

GEO. R. FOWLER (Brooklyn).

IX. **Incarcerated Hernia**. By CHR LANGE (Copenhagen). The writer bases his work upon three hundred cases of incarcerated inguinal and crural hernias. The results are illustrated by tables and diagrams which make it unsuitable for a short extract.

He draws, from his statistics, the following conclusions in regard to treatment:

1. The most important and decisive factor in the prognosis of an incarcerated hernia is the length of the time which passes before the termination of reposition.

2. When the incarceration has lasted less than 12 hours, the prognosis is good and taxis may be applied with great force, without danger.

3. When incarceration has lasted about 24 hours there is some danger for the patient's life. Taxis may still be used with quite a good deal of force.

4. When the incarceration has lasted 36 hours or longer the prognosis is very doubtful. Taxis should only be applied with caution, and especially in:

a. Incarcerations with violent symptoms.

b. Crural hernias.

c. Primary incarcerated hernias, which are of a quite small size.

d. Cases where parietal hernias are suspected.

5. The most careful antisepsis should be carried out during herniotomy and especially when the hernia is large.—*Hospitals-Tidende*, R. 3, bd. 7, p. 107, 129.

X. Treatment of Ileus. By Dr. KAPTEYN. The author was called to a case of ileus. When he saw the patient he was not yet very much collapsed, and Kapteyn could detect with his finger, 8 cm. distant from the anus, an invagination of the intestine. An injection of water, with the patient in a kneeling and strongly bent position, completely removed the invagination. After evacuation of the water small doses of opium were given, and thirty-hours later a normal passage of fæces took place.

The author gives, according to his experience with ileus, the following conclusions for its treatment:

Opium is a dangerous remedy in ileus and other kinds of internal incarceration.

2. In cases of recent invagination, injections of water or introduction of air into the rectum are recommended.

3. If reposition of the incarcerated portion of the intestine cannot be accomplished by injections of water or introduction of air, then one should not hesitate to perform laparotomy.—*Weekbl. van het Nederl. Tijdschr. voor Geneesk*, 1889, II., No. 25.

XI. Two Cases of Gastroenterostomy. By C. STUDSGAARD (Copenhagen). The writer after some historical remarks upon the evolution of the operation as a palliative in those cases where resection of the pylorus is impracticable, traces the principal points of the operation. He demonstrates the difference between Wolfler's method and that of Courvoisier, finally coming to a description of two cases operated on at the Copenhagen "Kommune hospital". Both of the patients were women. The first, operated upon Courvoisier's method, died 7 hours after the operation; the second, operated upon by Wolfler's method was still alive, 7 months after the operation, freed from her pains and attending to her work. She had been confined to bed for 5 months before the operation.—*Nordiskt Medicinskt Arkiv.*, bd. 21, hft. 3.

XII. Neoplasms of the Abdominal Walls. By VILH. HEIBERG. The writer, after a review of tumors of the abdominal walls and their treatment, communicates three cases:

I. The first patient was a woman who had borne two children, the last six weeks before. For about ten weeks she had noticed a tumor to the left of the umbilicus; it had grown progressively during the last pregnancy and upon her entrance to the hospital it was of the size of a man's closed fist. The growth was extirpated together with a portion of the peritoneum which was adherent to it. Recovery took place. The tumor proved to be a fibroma arising from the most posterior layer of the sheath of the rectus muscle.

II. The second was a woman, æt. 32 years; she had borne two children, the last one three and a quarter years previous. In the course of one-half a year a firm and roundish tumor had developed to the left and a little below the umbilicus; the growth was 4 by 5 centimetres in size. Recently pains had been felt in the tumor. Extirpation was done. A piece of the parietal peritoneum about 8 centimetres square was excised with the neoplasm. Recovery. On examination the growth revealed itself to be a fibroma, originating from the most anterior layer of the sheath of the rectus.

III. The third case was that of a woman, æt. 50 years. She had passed through 11 pregnancies, and aborted once 7 years ago. Simultaneously she remarked a lump in the abdominal walls, which grew and was extirpated $2\frac{1}{2}$ years before. One year ago the growth recurred, it having its site in the right hypogastrium. The patient suffered from pains in and radiating from the tumor. Extirpation was performed and the peritoneum removed from the posterior surface of the tumor above, while below it was preserved as a flap with the base towards the left; the flap was about 3 to 4 inches long and 2 inches broad. The wound could only be closed above and below, in the middle it being only closed by the peritoneal flap, which was stitched to the peritoneum of the right border of the wound. The patient recovered; a good firm cicatrix was formed by granulation.

The tumor, which weighed $3\frac{1}{2}$ pounds, measured 8 by 15 to 17 centimetres (in different regions) and was 9 centimetres thick. It was a spindle-celled sarcoma.—*Nordiskt Medicinskt Arkiv.*, bd. 21, heft. 3.

GYNÆCOLOGICAL.

I. Elephantiasis of the Clitoris and Vesico-Vaginal Fistula of Non-Traumatic Origin in a Syphilitic Subject; Operation; Cure. By Prof V. Lauro (Naples). The patient, æt. 27, had not suffered of any disease during her infancy, and began to menstruate at her twelfth year. In her thirteenth year she was attacked by measles. When eighteen years old, she became a prostitute and soon after this was suffering from blenorrhagia and syphilis. After these diseases the sexual appetite, which, during the acute and sub-acute stages, had become diminished, increased, and the patient became addicted to masturbation. Examination of the genital organs revealed the following: Enormously enlarged clitoris, upon which another neoplasm was discovered, which was 20 cm., long and somewhat smaller than the pathological clitoris; normal nymphæ, except that the left gave off a band, about 8 cm., long, the tissue of which resembles that of the nympha. Urine dribbled from the vagina; behind the orifice of the urethra a solution of continuity was detected, which was divided by a septum, and lead into the urethra. Besides, a fistula was detected in the vaginal wall, back of the first, corresponding to the neck of the bladder, from which urine dribbled away. This latter was circular and 5 mm. in diameter.

Diagnosis.—Elephantiasic hypertrophy of the clitoris and its adjacent structures, urogenital fistula in communication with the vagina in a syphilitic patient.

In order to repair these defects Prof. Morisano (who operated on this case) removed the hypertrophied organ together with the nymphæ by the knife and closed the fistulæ. after freshening up their edges, according to Sim's method and his own modification of the latter. The resulting cure was complete. The author, after discussing the causes and pathology of this disease, concludes that it resembles essentially elephantiasis. The histologico-pathological examination of the removed tissues showed them to be of an elephantiasic nature. The band of tissues which extended from the nymphæ and prepuce of the clitoris were caused by adhesion which was the result of contact of the

parts during cicatrization in the healing process of former ulcerative (syphilitic) lesions. An uro-genital fistula caused by syphilitic ulcerations is rarely met with in practice, and some gynæcologists even deny it. The clinical observation observed by the author "dissipates," he says, "every doubt."— *Gazzetta degli Ospitali*, September, 1890.

II. Congenital Absence of the Vagina; Rudimentary Uterus; Integrity of Its Appendages; Autoplastic Operation with a Successful Result. By DR. SAMUEL GACHE (Buenos Ayres, S. A). Josephine, a young girl, æt. 17, in good health and without any hereditary antecedents, other than that her father, at the age of 47 years, had died of pulmonary tuberculosis, presented herself at the hospital for treatment. Physically, she was poorly developed, indeed she was of a nervous and sympathetic type, but neither hysteric nor subject to hysteriform crises. At the age of 13, she suffered chorea of the right side of the body, which disappeared under the influence of a treatment with bromides. She has never menstruated, neither has she suffered from pains in the abdomen. Six months before entering the hospital she experienced darting pains in the hip and muscles, which reappeared two or three times a month without regularity. She never has noticed any supplementary hæmorrhages. At the age of 16, she attempted to perform coitus and found it impossible. She then entered the hospital of her town, where she was told that she had an imperfect hymen; nothing, however, was done to relieve her.

On examination, the external genitals were found to be well formed; the pubes abundantly covered with hair, the labia majora thick and large, the labia minora well developed. On separation of the labia absence of the vaginal orifice was noticed; in its place a hard and fibrous membrane, slightly depressed in its center and uniting the base of the labia minora occupied the place of the vaginal introitus. The urethral opening was in its normal site. By examination, per rectum, which was in its normal position, its anterior wall was felt to be in immediate contact with the bladder and no trace of the vagina could be made out. The finger, pushed high up in the rectum, detected the rudimentary uterus as a small and hard body of the size of a hazel-nut.

The tubes and ovaries were also palpated and found to be of a normal size.   A transverse incision was made into the membrane occluding the space between the labia and the rectum and bladder carefully separated by the fingers and a spatula without much difficulty.   The division of the adhesions was controlled by one finger in the rectum and a silver sound in the bladder. After penetrating to a depth of seven centimeters the newly-made vagina was lined by a cutaneous flap taken from the perineum and one formed by the mucous membrane from the labia minora and the base of the labia majora.   These were fixed by sutures and the vagina packed with iodoform gauze, while the bowels were constipated for several days. The flaps healed by first intention and at the end of six days union was complete.   The newly-formed vagina measured seven centimeters in length and was well lined in its whole extent.   In order to prevent threatening contraction it was, twice daily, packed with iodoform gauze, and two weeks after the operation digital dilatation was done every three days.   One month after the operation the patient left the hospital in good health, and with a vagina seven centimeters in length, which permitted the introduction of the entire index finger.—*Anales del Circulo-Medico-Argentino*, July, 1890.

F. H. PRITCHARD (Boston).

ON THE PATHOLOGY OF APPENDICITIS.

By HERMAN MYNTER, M.D.,

OF BUFFALO,

PROFESSOR OF SURGERY IN THE NIAGARA UNIVERSITY.

IN SEPTEMBER, 1879, I read a paper on perityphlitis, as it was then called, before the Buffalo Medical Association, calling attention particularly to the operative treatment, then new, as advocated by the late Dr. Gurdon Buck. In discussing the pathology I followed the nomenclature of my distinguished teacher, Professor With, of Copenhagen, who described three forms of appendicitis, namely:

1. Peritonitis appendicularis adhesiva, in which the ulceration in the appendix goes so deep that the peritoneal covering is affected and adhesions are formed.

2. Peritonitis appendicularis localis, characterized by local peritonitis and primary abscess

3. Peritonitis appendicularis universalis, in which we have diffuse peritonitis by perforation into the peritoneal cavity.

The cases belonging to the first division were those with obscure symptoms, local tenderness in the ileo-cæcal region, a little vomiting and general ill-feeling for a few days. I stated that they recovered generally promptly by rest, opium, poultices and avoiding cathartics, but that they frequently relapsed and might then be followed by the more severe or fatal forms.

The second form, peritonitis appendicularis localis, I described as characterized by local abscess, generally and primarily intra-peritoneal, but on account of adhesions in reality extra-peritoneal, and extending downward toward Poupart's ligament, above which they might and ought to be opened by operation as early as possible in order to avoid secondary perforation into the abdominal cavity.

The third division, peritonitis appendicularis universalis, I stated could either start as such, if the perforation took place before adhesions had formed, or by secondary rupture of a well-developed abscess. I stated twelve years ago that they almost universally terminated fatally in a few days, that no known treatment was of any avail, but I expressed a belief (page 122, *Buffalo Medical Journal*, 1879) that the time would surely come, when we, in such cases, would open the abdominal cavity and ligate the appendix.

During the last twelve years a great deal has been written about appendicitis, and it is now almost universally acknowledged that it is a distinctly surgical disease, which can be treated by surgical means only, particularly in its more severe forms, where we have either a circumscribed abscess or a diffuse peritonitis.

The three divisions—adhesive, circumscribed, and diffuse peritonitis—are still more or less recognized as the different forms, perhaps under slightly changed names, and the pathology is in most points fully understood and almost beyond discussion.

Bull ("Transactions American Surgical Association") distinguishes between a catarrhal perityphlitis tending toward recovery, but then leaving behind adhesions to the parietal peritoneum, the omentum or the intestines, and a suppurative perityphlitis, which either may be spreading (diffuse peritonitis) or limiting (circumscribed peritonitis), followed by extra-peritoneal abscess.

A catarrhal perityphlitis may go on, he thinks, to a suppurative form too. He considers perityphlitis an inflammation of either cæcum or the appendix with their peritoneal covering on the cellular tissue in the iliac fossa. He thinks it impossible to distinguish between an inflammation of cæcum and the appendix, but, like most writers, believes ulceration leading to perforation more frequent in the appendix. He also mentions that catarrh of the cæcum in which the appendix participates, is of frequent occurrence.

McMurtry, of Kentucky, on the other hand, thinks as most other writers do, that disease about the caput coli in almost every case starts in the appendix, and that inflammation of the cæcum

itself is very rare, although primary perforation of the cæcum may occur without appendicitis. Regnier mentions such a case (1886) and McMurtry another.

My personal opinion is that it may start in either, but with a great predilection for the appendix. Catarrh of the cæcum with dilatation I consider quite frequent, and it is probably followed with catarrh and dilatation of the appendix and its opening into the cæcum, "Gerlach's valve,"so that the contents of the bowels enter with greater ease. The appendix has a relatively large absorbent surface so that the fluid is absorbed while the solid parts are left and form concrements, which again probably are the mechanical causes of inflammation, ulceration, and relapses.

Krafft (*Volkmann's Klinische Vortræge*, January, 1889) thinks resolution impossible, and believes that there is always a pus focus left which may become encapsulated and give no further symptoms, but which also, on slight provocation, may start the inflammation up again. In 84 cases out of his statistic of 106 cases an autopsy was made and in each case an ileo-cæcal abscess found. He also believes perforation of the cæcum always to be secondary, the abscess perforating into the cæcum instead of elsewhere. That resolution may, and does, take place, is conclusively proved by my countrymen, Dr. Toft, of Copenhagen, who, while prosector to the "Royal Frederiks Hospital," found residua of appendicitis in the form of adhesions in 35 per cent of all post-mortem examinations made. It also shows the frequency of the disease.

Mikulicz, of Königsberg (ANNALS OF SURGERY, October, 1889), distinguishes two forms of perforative peritonitis. The first form, diffuse septic peritonitis, results when a large quantity of intestinal contents suddenly pours into the abdominal cavity through a large perforation. The resulting peritonitis is characterized by sanguino-serous or purulent, thin putrid, fluid exudation, injected peritoneum, at times covered by thin fibrinous exudation. Extensive adhesions are lacking, as the patient dies before they can form.

In the second form, which he calls progressive fibro-purulent peritonitis, the peritoneum is first only affected in the immediate vicinity of the perforation, a fibro-purulent exudation

is formed, which prevents by adhesions the infection of the whole peritoneal cavity. The process may spread, closely followed by new exudations, and incapsulated pus foci are formed between the glued intestines. Mikulicz opened in one case six intra-peritoneal pus-cavities through three incisions, in another three pus cavities through three incisions. The openings were made at different times as the existence of the pus foci became evident.

Why we should find this slow progressive form in some cases, and in the majority of cases a violent septic and rapidly fatal peritonitis, is not clear. Less stress has probably been laid upon intestinal microbes than they deserve. It is probably not so much the concrements or the pus that produce the diffuse septic processes in the peritoneum after perforation as it is the pathogenic bacteria, with which the intestinal contents are teaming. Lewis Smith thinks that atrophy and necrosis of the epithelium take place from pressure of foreign substances, that intestinal microbes thereafter invade the exposed sub-epithelial tissue, causing septic inflammation, which extends through the muscular coat to the sub-peritoneal tissue and to the peritoneum, causing local or diffuse peritonitis according to the rapidity of the process. The inflammation may also cease before reaching the peritoneum, causing gangrene and ulceration of the deeper tissues and causing *either* obliteration of the appendix from cicatricial contraction during healing, *or* else stricture of the appendix, particularly the proximal end, while the distal end remains patulous and may form a retention-cyst. This cyst may again subsequently inflame, perforate, and give peritonitis, but probably not a diffuse septic form, but a fibro-purulent form after Mikulicz. Stimson mentions these strictures too, considering them the result of cicatricial contraction and possibly occasionally from congenital defect.

Treves (Discussion in the British Medical Association, August, 1889) does not believe in a catarrhal form of perityphlitis. The perityphlitis is always, in his opinion, produced by ulceration and the symptoms first occur when the ulcers have extended to the outer wall. Be that as it may, I have no doubt that the concrements are the cause of the ulceration and

the catarrh and dilatation the cause of the concrements.

While the three divisions hold good in a large number of cases, it must not be forgotten that pathologists have arrived at this conclusion by examining old and probably neglected cases of appendicitis. It is first during the last two years that a larger number of early laparotomies have been performed on account of acute appendicitis, and that an opportunity of studying the pathological process in the start has offered itself. I believe that to my friend, Dr. McBurney, of New York, belongs the credit of pointing out the real condition of the pathological process in the appendix and of showing that, in some cases at least, we may find no adhesions, and that the large, swollen, almost or wholly gangrenous, appendix may be found freely movable in the abdominal cavity and ready to burst, and without any limiting adhesions to protect the peritoneal cavity. He draws his conclusions from early operations for appendicitis and has found the most varied conditions, from a mild catarrhal condition of the mucous membrane accompanied by some infiltration and thickening of the submucous tissue, to the state of complete gangrene of the whole organ with more or less extensive peritonitis. In one case, operated during a period of health on account of twelve attacks during one year, the appendix was found rigid, swollen, the mucous membrane mildly inflamed, the other tissues thickened but without any evidence of peritoneal inflammation or adhesion.

In another patient who had had four attacks, the operation, performed during health, revealed the appendix firmly bound by old adhesions to the under surface of the intestinal mesentery and cæcum; the appendix was dark-colored and swollen, and there was evidence of former limiting peritonitis. Both of these cases would probably later have terminated in abscess and peritonitis. In one case the appendix formed a cyst containing ℥j dark-brown pus.

In several it was swollen, discolored, but gangrenous only at one or two points where perforation had occurred, and in these cases one or more fæcal concretions existed either within or just without the appendix.

In other cases the appendix was only moderately diseased, but perforation had occurred and recent adhesions had tied it

to some adjacent part, doubling it upon itself and so enclosing a small collection of pus with or without concretions.

In two cases the appendix was completely gangrenous. In all of these cases a plastic peritonitis of greater or less extent existed, always involving the cæcum and generally the adjacent intestinal coils and abdominal wall. In no case was extra-peritoneal inflammation observed. In most cases pus was found more or less confined by adhesions within a limited area, and in one case absolutely no adhesions of any kind existed, though the appendix was perforated by concretions and very foul pus filled the pelvis and ran freely upwards beside the colon.

I have quoted my friend, Dr. McBurney, so freely, because his contribution to the pathology of appendicitis, dependent as it is on personal observations from a number of early laparotomies for appendicitis, is of far greater importance than those observations made in post-mortem examinations upon old and neglected cases. It shows also our utter inability to judge correctly from the symptoms alone about the extent and severity of the lesion, and that from that reason alone laparotomy is and must be the safest method of treatment.

Stimson (*N. Y. Medical Journal*, October 25, 1890) found the same difference in eight early laparotomies in regard to the position of the appendix and the intensity of the inflammation; and in two of these cases, at least, found no limiting adhesions, although perforation from gangrenous spots had occurred. In only one case a foreign body or fæcal concretion was found, but in all marked inflammation of the mucosa, almost obliterating its structure by studding it with round cells. Total or partial obliteration was found in three cases. The pus was intra-peritoneal, except in one case, in which it was found between the layers of the mesocolon. Concrements were only found in one case.

The question whether a perityphlitic abscess is intra- or extra-peritoneal, has been debated again and again. I see no reason for any disagreement on this point. Both cæcum and the appendix are, according to Bull and others, always completely invested with peritoneum. An abscess starting in the appendix must necessarily in the start be intra-peritoneal

limited by adhesions. If the adhesions are strong and exuda-
tions continue to be deposited, so that perforation into the ab-
dominal cavity is prevented, the parietal peritoneum may be-
come perforated and the pus is then in the extra-peritoneal
tissue in the iliac fossa, *i. e.*, an extra-peritoneal abscess, and
may be opened by an extra-peritoneal incision above Poupart's
ligament or perforate somewhere else, as into the rectum,
the ischio-rectal fossa, or backwards.

McBurney thinks they are always intra-peritoneal and that
it is always necessary to cut the peritoneum in order to open
such an abscess. I think he stretches that point and I dis-
agree with him.

In one case I discovered a distinct hour-glass abscess con-
sisting of a larger extra-peritoneal abscess, which I opened,
and which with a round opening was connected with a deeper
lying abscess, in which I could distinctly feel the appendix and
a concrement, which I removed. In another much neglected
case to which I was called four weeks after the patient was
taken sick, because the physician could find no abscess,
although looking for it, I discovered an enormous abscess
ready to break through Pettit's triangle between the latissimus
dorsi and external oblique muscles. Both were extra-peritoneal
abscesses although starting as intra-peritoneal abscesses, and
in neither was the peritoneum cut. That they are rare is
sufficiently proved by Robert Weir, who in 100 autopsies
found diffuse suppurative peritonitis 57 times, circumscribed
abscess 35 times (in 13 of which diffuse peritonitis was present
too) and extra-peritoneal abscess only in four cases. In each
of these four cases there was a large ragged opening, showing
that an ordinary necrotic process of the peritoneal wall had
made the abscess extra-peritoneal.

Krafft mentions flexion of the hip-joint as characteristic of
appendicitis, but I must disagree with him on that point. I
never saw flexion, *i. e.*, contraction of the ilio-psoas muscle,
in appendicitis, and I see no reason why it should occur. The
strong fascia iliaca is between the abscess and the muscle;
otherwise the point of perforation of the abscess, if left to it-
self, would be down on the femur below Poupart's ligament.
Contraction of the ilio-psoas muscle, in short, occurs only

when the muscle either is acutely inflamed (acute psoitis) or perforated and infiltrated with pus from a cold abscess depending upon caries of the spine, necrosis of the pelvis, etc.   A few words may be said about the statistics of relapses, perforations, and fæcal concretions.   A person who has recovered from appendicitis without operation is ever after in danger of a relapse, which may be either mild or the most severe form of perforative peritonitis.   Krafft mentions a statistic of 106 cases of which 24, *i. e.*, 23 per cent had had previous attacks, generally one to three years previously, in one case twenty years previously.   Treves mentions one case who had 14 attacks, McBurney another with 12 attacks inside one year.   In regard to perforations, Matterstock found perforations in 132 out of 146 cases, Fenwick in 113 out of 129 cases, *i. e.*, 90 and 86 per cent.   The perforation is usually at the free end but may be circular, and as Krafft says, so to speak amputate the appendix.

In Matterstock's 146 cases fæcal concretions were found 63 times, a foreign body 9 times.   In Krafft's 106 cases 36 fæcal concretions and 4 foreign bodies were found.   Only small bodies can enter on account of Gerlach's valve.   A cherry-pit may enter with difficulty, a plum-stone not at all.

In regard to age, Matterstock found in 72 cases, 2 under 2 years of age; 10 between 2d and 5th year; 25 between 5th and 10th year; 35 between 10th and 15th year, which seems to show that childhood is most predisposed.   This does not agree with other authors.   Of 14 cases I have seen myself, only 1 was a child, a boy 12 years of age; all the rest occurred in adults, and quite a number in people over 40 years of age.   One only was a female, the rest males.

THE INDICATIONS FOR EARLY LAPAROTOMY IN APPENDICITIS.

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THE title of this paper is one which a very few years ago, not more than four, would have excited the surprise and even the condemnation of many surgical and medical practitioners. The very fatal character of the disease formerly known as perforative inflammation of the vermiform appendix was thoroughly appreciated much longer ago than that, but this form of the disease was looked upon as a disease *sui generis*, as beginning with a distinct intent, and as terminating fatally. And it was not until 1886 that the cloudiness surrounding the peri-cœcal inflammations was largely dispelled by the remarkably clear and able paper read before the Association of American Physicians by Reginald Fitz of Boston. Since that time much attention has been paid to this subject both by surgeons and physicians, and I know of no surgical topic to which more frequent contributions have been made by surgeons from all parts of this country than that now recognized as inflammation of the vermiform appendix, or appendicitis. The pathology of the disease has been closely studied, and a vast amount of information in this field has been gathered together, the most valuable part of which has been only recently contributed by physicians and surgeons, who, embracing the opportunity afforded by early operations, have been able to study the pathological processes from their inception. We have learned to discard the terms typhlitis, perityphlitis, paratyphlitis, extra-peritoneal abscess of the right iliac fossa

and the like, except when we wish through the use of these terms to indicate a secondary or late process, but one originating almost without exception in an inflammation of the vermiform appendix. We have learned that there is no such disease as idiopathic peritonitis, and that, excluding the special causes of peritonitis, which exist in the female, the cause of the vast majority of cases of peritonitis is an inflammatory process originating in the appendix. We have learned that appendicitis is a disease of frequent occurrence, that it is responsible annually for a large number of deaths, and that none of the older methods of treatment afford the practitioner any actual control of the disease, although medical treatment, rest, and intelligent nursing are doubtless of great value in limiting the extent and shortening the duration of the milder attacks. But, lest I give a wrong impression, I must distinctly state here, that there are many cases of appendicitis of a mild character which rapidly convalesce under no other treatment than that just referred to, and that not a few severe cases eventually recover without other active aid. Nevertheless the mortality under conservative treatment remains large, much larger, I am firmly convinced, than any statistics can prove, for many fatal cases occur whose true origin has never been suspected, and some cases too, which pass through one attack successfully, and are so noted, come finally to a fatal attack at a distant period. I may mention as an illustration of the difficulty of collecting complete statistics of the mortality of the disease under discussion the following incident: Not long ago I met in consultation over a severe case of appendicitis, one with very unfavorable signs, a gentleman much older than myself and of very large experience. I advised an operation as urgently called for, and he entirely opposed the proposition. In explanation he added that although he had in his long and active practice "met with many such cases" *he had never known one to terminate fatally.* In a discussion recently taking place at a meeting of a Surgical Socity, one member referring to appendicitis, said, that although he had seen such cases for years, none had terminated in abscess or death and none had recurred. The statistics given by close observers justify one in concluding from such remarks as those just quoted, that

many fatal cases are certainly not recognized at all. Fitz, in his remarks made before the Association of American Physicians last year, gives the mortality as 26%. L. A. Stimson, in a paper read before the Surgical Society of New York, on October 8, of last year, gives the mortality as 25%, and these percentages are so trustworthy and are made up from such a large number of personal cases that they may fairly be used as a basis for discussion. (It is not my purpose, however, to endeavor carefully to estimate the mortality from appendicitis, and I have referred to the above statistics only that I might impress the fact that in discussing the treatment of appendicitis we are discussing the treatment of a disease, which when all cases are treated conservatively, kills a great many people. While the diagnosis of an inflammation of the appendix is usually not difficult when a careful examination is made, and is often very easy, yet, I know of no localized disease which is capable of presenting such a variety of pathological processes. The real difficulty lies in estimating at an early period the probable behavior of each individual case, and yet, on such estimate on the part of the attendants will depend the line of treatment.)

I must, therefore, dwell on the diagnosis of the disease and endeavor to weigh the value of each symptom. Abdominal pain of greater or less severity is usually the first sign of appendicitis, but valuable time is often lost by reason of the misleading character and position of the pain. It is, at first, often referred by the patient to the whole abdomen, frequently to the epigastrium alone, sometimes to the umbilical region, and only in about half the cases does it begin at once in the right iliac fossa. But after a few hours or a day, it becomes more and more evident that the chief seat of pain is in the iliac fossa and then the diagnosis is generally made. The *slight* character of the pain is sometimes seriously misleading, so that a diagnosis of mild enteritis, constipation or colic is sufficient to satisfy both physician and patient. In some cases a prodromal stage of abdominal discomfort lasting a week, or even longer, precedes real pain. (I have found the *exact* locality where the greatest sensitiveness to pressure exists to be a valuable means of diagnosis, so that in every case of abdominal

pain, not otherwise satisfactorily explained, I make a careful search for it.   In the first hours of an attack of appendicitis it is not enough to compress with the whole hand the region of the iliac fossa.   Such pressure will often elicit no more complaint from the patient than pressure of a similar kind made at other parts of the abdomen.   But if firm pressure is made with the finger-tip, and especially if the patient be made to cough while such pressure is being exerted, it is invariably easy to determine that the most sensitive point is a definite one in most cases.   This point is very accurately in the adult from 1$^1/_2$ to 2 inches inside of the right anterior superior spinous pro- cess of the ilium on a line drawn to the umbilicus.   In chil- dren it is, in proportion to their size, so much less distant from the spinous process.   Occasionally this most sensitive spot will be found a half inch or so nearer the pubes, and sometimes this sensitive area will be larger than usual, but from the first hours of the disease even up to the end of several days, this sign may be clearly made out in every case.   No other acute dis- ease presents this feature.   The accuracy of this sign I have demonstrated in every case operated upon by me since I first made the observation.   The point described corresponds very accurately in the living subject, to the base of the appendix, and for this reason the sign is clearly defined whether the ap- pendix is long or short, or points up or down.   Of course, in late stages of the disease this sign does not usually exist.) My friend, Dr. Weir,[1] commenting upon this observation of mine as to the exact spot of extremest sensitiveness on finger-tip pressure, does not agree with me as to its value, and says: "Fur- thermore, I have myself found on examination of 18 healthy persons by the above test of McBurney, that in 4 of them de- cided evidence of tenderness existed without other history of appendical attacks."   When we remember that in 300 autop- sies made at random by Tofft, 36%, over one-third, revealed evidence of disease of the appendix, Dr. Weir's examination would seem to be a singular confirmation of the delicacy of the test.   Four out of the 18 is below the average.   With the initial pain some patients have a chill, and vomiting may be

[1]Philadelphia Med. News, March 1, 1890.

severe. In other cases both or either of these symptoms may be absent. Fever to some extent is soon present in all cases except the mildest, but it varies greatly in degree, some cases having a temperature on the first day of less than 100°, others rapidly reaching a temperature of 103.5°. Rigidity of the muscles on the right side is a very constant sign and one of value.

The extent of tympanites varies greatly and its degree does not measure the severity of the disease at the onset. It may be very decided during the first day in some moderate cases and even entirely absent in some of sudden perforation. This sign must depend for its existence largely on the state of the patient's bowels, the ease with which the intestine in a given individual is brought to a state of paresis, and on other causes. As a rule, rapidly increasing distension is a positively unfavorable sign. Tumor may or may not be appreciable during the first two days. Sometimes the enlarged inflamed appendix itself can be distinctly felt at a very early period. As a rule, with few exceptions, tumor can be detected by the end of the second or third day. In very mild cases it is absent. The tumor consists of the appendix alone, or of the appendix surrounded by thickened omentum or inflamed œdematous intestine. Within the tumor pus is frequently found but it is often absent. The percussion note is not necessarily dull. Tympanitic percussion may be noted, due to the fact that a portion of intestine full of gas lies over the tumor. Generally the patient complains if the right thigh is over extended, and he will object if he is asked to cough. Rectal examination at the onset is of no value. The pulse deserves careful examination. By its variation from the normal condition it often indicates the severity and the increase of the disease, as it always expresses the amount of constitutional disturbance.

But few signs, then are constantly present within the first 24 hours. The history of sudden onset, the point of greatest sensitiveness to pressure exactly localized over the situation of the base of the appendix, fever as shown by the thermometer and the pulse, and rigidity of the right abdominal muscles, are the most constant and valuable signs in making an early diagnosis. In very mild cases no sign may be present excepting that of sensitiveness at the point described.

The making of an early diagnosis is of the greatest import-
ance in reference to treatment.   When no diagnosis is made
opiates are usually freely given to subdue pain, more or less
intestinal paresis and distension result, and pain being obliter-
ated the arrival at a correct diagnosis is postponed from day to
day.   I have been asked to see a number of cases treated in
this manner, and in most of them the diagnosis had been made
with difficulty.   Of the use of the hypodermic needle as an
aid to diagnosis I can only say that I think it should never be
used.   If it discovers pus it may still have done harm in find-
ing its way to or from the pus, and if it does not discover pus,
the negative evidence thus procured is of no value. What is the
value of pain as a measure of the gravity of an individual
case ? If great intensity of pain always existed in grave cases
or if great intensity of pain always marked a serious and ad-
vanced stage in the pathological process, we should have no
difficulty in separating our cases into two classes, one consist-
ing of the mild ones and another of the severe ones.

In illustration let me quote briefly two cases: One, a healthy
young man, had been attended for two days by two extremely
competent physicians.   His pain had been so slight, his fever
only 100°, and his other symptoms so mild, that no diagnosis
had been reached.   On the third day, without special aggrava-
tion of any symptom, he looked more ill and felt so.   Never-
theless, when I visited him with the late Dr. Sands he had be-
come already septic.   Laparotomy was almost immediately
done.   The appendix was found much inflamed and partly
gangrenous.   It was perforated by a large concretion. No ad-
hesions of the slightest kind existed, and the whole pelvis was
full of foul pus. Another, also a healthy young man, had such
severe pain that during the first twenty-four hours that his phy-
sicians gave him one and one-half grains of morphine, without
securing complete relief.   When I did a laparotomy on this
patient I found an appendix with only moderate signs of in-
flammation on its interior, and absolutely no peritonitis.   This
appendix contained six fæcal concretions.

But subjective pain as described by the patient is one thing,
and sensitiveness to pressure when a careful examination is
made is another.   The latter is the sign that is of value. Dur-

ing the first twelve hours many cases, destined to develop the
disease to very different degrees, will behave very much alike.
Some will continue to go about with little complaint, others
will lie still because motion causes pain, and they are fairly
comfortable when at rest. Others will have very great pain,
with nausea, vomiting and complete disability from the first
hour on. Some will have during this period a quite ordinary
pulse of 80 to 90, and a normal or very slightly elevated tem-
perature, while others, beginning with a chill, will have a full
bounding pulse, a flushed face, and a temperature of 102°, or
more, from the onset. Every one of these cases deserves the
most careful attention. Why? Because every one of them
has, so far as our present knowledge goes, the beginning of
an inflammatory process within the peritoneal cavity, the full
development of which not one of us can forecast at this stage.
Within the second or third twelve hours the signs may become
much more clear. For treatment these different cases should
all be kept absolutely at rest. Vomiting, especially, should
be controlled as completely as possible—if necessary, by total
disuse of the stomach. Anodynes, when really necessary to
procure immobility or a moderate amount of comfort, are in-
dicated. Vomiting ceases soon, and the stomach can then
bear light nourishment. Laxatives should be carefully
avoided, and enemas as well, that all peristaltic action may be
discouraged. As a local application over the cæcum and ap-
pendix, cold is by far the best. The India rubber cold coil is
the best apparatus. Under this treatment, cases that have be-
gun with very mild symptoms will usually, at the end of twen-
ty-four hours, either become milder or cease to advance and
one will be encouraged to continue the same plan, still being
carefully on the lookout for the development of tumor con-
taining pus, which may quietly form, although other signs are
favorable. The more marked cases, those with fever of 101°
or 102°, with decided sensitiveness to finger-tip pressure, and
with a more rapid pulse, indicating more constitutional dis-
turbance, may come to a standstill, or may show increased
signs of progressing disease; and the cases that began with
high fever, very great pain and frequent vomiting, will usually
at the end of twenty-four hours begin to show abdominal dis-

tension, increasing distress, and many signs common to serious illness.

A class of cases which I have as yet purposely avoided describing is that generally described under the head of Perforative Inflammation of the Appendix.

I think a common misapprehension exists as to this class. When perforation of the appendix takes place suddenly at the very beginning, pain is usually for a while intense. Symptoms of shock more or less clearly defined exist, and these are rapidly followed by chill or fever, or both, by extended pain, vomiting and tympanites. Septic peritonitis is beginning, and the patient is often treated for "sudden peritonitis." But perforation of the appendix by concretion, foreign body or retained pus, may be quite late in its occurrence. If, before its occurrence, safe adhesions have formed about the appendix, the perforation will take place without special sign, and usually an abscess is formed. On the other hand, perforation may not occur at all and yet pus be rapidly formed. If limiting adhesions do not exist, or if the adhesions are incomplete or feeble, pus may flow over into the pelvis, and produce precisely the same sudden aggravation of symptoms, or even worse, as when the appendix is perforated at the beginning of the attack. On Friday, October 10, last, a boy, æt. 12, was seized with abdominal pains at noon. He went home from school, and was visited by Dr. A. M. Hurlbut, of Stamford, Conn., a most careful observer. The boy had slight pain only, with no fever, he was tender on pressure over the appendix, and the diagnosis of appendicitis was made by Dr. Hurlbut. After a quite comfortable night, the temperature was below 100° in the morning of the 11th, and remained at the same point that evening. The boy had been kept in bed and carefully watched, Dr. Hurlbut intending to send for me if signs of progressive disease appeared. At one o'clock on Sunday morning, the 12th, the boy woke with intense pain and vomiting, and was seen within an hour by Dr. Hurlbut, who found him pale, almost pulseless, very tender all over the epigastrium, and with a temperature by the mouth of only 98°. I reached Stamford by the first train, and as it was Sunday the first train was an afternoon one. At 3 P.M. the boy's tempera-

ture was 102.5°, and I did laparotomy. When the peritoneum was cut turbid serum in quantity poured out of the incision. The appendix was partly gangrenous, perforated by a fæcal concretion, and surrounded by an imperfect collapsed abscess wall. In the pelvis was more than a pint of purulent liquid, and intense septic peritonitis existed all over the lower half of the abdomen. It is certain that in this case the sudden pain and collapse at the thirty-seventh hour were caused by the rupture and overflow into the pelvis of a feebly protected abscess. I have quoted this case to show that, while perforative inflammation of the appendix is often spoken of as a disease beginning with marked signs of perforation and only to be treated with any hope of success by immediate operation, it may occur, and it often does so occur, as a somewhat later step in an attack commencing like a mild one. The rupture of an abscess into the peritoneal cavity at any period in the course of the appendicitis, causes the same symptoms and usually the same fatal result that the sudden early perforation of the appendix causes.

I have referred to the period of twenty-four hours as one at the end of which the character of an attack should be closely studied and a careful estimate of the probable behavior of the case should, if possible, be made. The character of some cases will be decided even before this time by the extreme severity of the onset. In these it will be evident almost from the first that perforation has already occurred, or that a considerable peritonitis has already begun. In the mildest cases at the end of twenty-four hours the symptoms will be diminishing slightly or will be at a standstill and the patient will clearly not be much ill. The more marked cases at the end of the same period will be a little worse. The tenderness on pressure will be more clearly defined, the temperature as high as, or higher than, it was a few hours before, the pulse will show increasing constitutional disturbance and a moderate tympanites may begin to be evident. And after this period the signs either of continued improvement or of increased disease will be constantly more clearly defined. Tumor may begin to be appreciable, tympanites will increase, and more especially will the examination with the tip of one finger re-

veal exquisite sensitiveness at the base of the appendix.
Even among these cases of increasing severity not a few will,
after a few days, begin to improve, the symptoms abate, even
a considerable tumor gradually or quite suddenly disappear
and the patient will have finished with one attack. Or, while
the patient becomes more comfortable in general, the tumor
increases in size, becomes very clearly marked, and an ab-
scess rapidly develops within the peritoneal cavity it is true,
but well limited by strong adhesions. Out of a number of
cases, all beginning in a somewhat similar manner, at the end
of a week some will have died from general peritonitis, sup-
posing them all to have been treated conservatively, others
will be well or on the road to recovery, and others again will
be waiting for the surgeon to open the abscess, running the
risk from hour to hour of serious accident. As Prof. Bridge
says :[2] "The abscess, wherever it is, and however well it may
appear to be surrounded by protecting plastic deposits, is a
constant menace to life, as evidenced abundantly by its spon-
taneous opening into the abdominal cavity, the venous canals,
the bladder and chest cavity, as well as externally, and into
the intestinal canal."

If one may judge from the description of appendicitis which
I have given, and this description is not so very different from
that given by numerous writers, we have to deal with a disease
presenting itself with a very unusual variety and irregularity
of symptoms, not difficult to diagnosticate, however, if careful
examination is made early, but the course of which it is prac-
tically impossible in almost all cases to prognosticate during
the first twelve hours. Our difficulties are again increased not
only by the large variety of pathological lesions belonging to
the disease, but also by the very great difference in the length
of time occupied by the disease in producing a complete
lesion, for instance, perforation of the appendix in one case,
from that occupied in producing the same lesion in another.
In one case the completion of the process of perforation may
occur within a few hours from the onset, in another perfora-
tion may not be complete up to the sixth day. All who have

[2] Transactions American Physicians, 1890, p. 31.

had practical experience with early operations for appendicitis will agree that we cannot in all cases at an early period of the disease, within the first two days, decide from signs and symptoms whether protecting adhesions are forming or have formed or not.   To be positive in regard to many points of the utmost importance we must wait.   If we wait long enough, say to the seventh, eighth or ninth day, many of these difficult questions will be solved, for one after another of our patients will have died, and one after another of our questions will have been answered.   On the seventh, eighth or ninth day we shall be able to muster together a more or less dilapidated majority of our cases, who will have successfully passed through many dangers, and not a few of whom now await the knife to give them the first opportunity to start on the road to recovery, a road by no means devoid of risk.   According to Fitz,[3] of 176 cases of perforative inflammation of the appendix, 60 died during the first five days, 46 during the first four days, and 28 during the first three days.   On the second day alone 8 cases died.   But this statement only represents the day of death.

In reference to treatment it is far more important for us to know *when that pathological process begins* which directly causes the deaths on the third, fourth and fifth days.   This process is usually sepsis and it is safe to say that in very large majority of the cases dying within the first five days, the fatal sepsis, hopeless for medicine, and nearly hopeless for surgery, *begins before the end of the third day*.   At what hour, if we expect to save almost all of our cases, the severe as well as the mild ones, must we decide how we will treat a given case?   Naturally before the process has begun which will soon render the use of medicine a farce, and an operation little better than an autopsy.   Should then all cases of appendicitis be operated upon on the *first* day so as to anticipate every danger?   Certainly not. As our means of diagnosis are improved, and as the study in the dead house has been more carefully directed to the appendix, we have learned that the class of extremely mild cases of appendicitis is large.   Within a year I have myself seen thir-

[3]Transactions of American Physicians, 1886, p. 126.

teen cases in which the diagnosis was clear and yet the attack
so mild that no one would have thought of recommending an
operation.   Nevertheless, even in such cases, at the very com-
mencement, during the first few hours of the attack, a decision
cannot always be safely reached at the first visit.   Each case
must be carefully and frequently studied if we would avoid on
the one hand the doing of unnecessary operations, and on the
other hand, the discovery that our patient, who was comforta-
ble in the evening, is on the following morning profoundly
septic.

The earliest possible diagnosis and frequent examination of
the patient may properly be demanded of every physician or
surgeon who is called to attend a case of appendicitis. Clearly
defined rules that will guide one safely in all instances in de-
ciding when a case of appendicitis may be safely treated con-
servatively cannot be laid down.   A general description, often
applicable, is the best substitute that I can offer.   The diag-
nosis having been made in a given case, the treatment already
described as applicable to mild cases should be at once insti-
tuted; anodynes should be carefully avoided, or at least given
so moderately as not to mask symptoms subsequently.   If
nausea disappears within twelve hours, if at the end of the
same period tenderness on pressure has not increased, if the
temperature remains normal, or has not risen to 100° in the
mouth, if the pulse is not accelerated, or but very little, if the
patient moves in bed with ease, one is justified in regarding
such a case as probably a mild one destined soon to recover.
If at the end of twelve hours more the same indications exist,
or there is very little change, the chance of a favorable ending
is still better.   If, during the succeeding two days, no tumor
has formed, the symptoms have all improved, or some have
improved while others remain stationary, the case may be
considered as practically safe, although complete rest should
still be enjoined.   A moderate enema may be safely given,
and often with benefit.   Within the week probably all symp-
toms of the disease, excepting perhaps a little tenderness on
pressure, will have disappeared.   In other cases one or several
symptoms will be more marked.   The temperature will from
the beginning be higher, perhaps rapidly reach 102°, the pulse

will be quick and full and nausea considerable but these
symptoms will not increase in severity and the general aspect
of the patient will be so good at the end of 24 hours that con-
servative treatment is clearly indicated. In these latter cases
a short interval of, say, twelve hours more, will usually de-
velop signs of improvement, or of cessation of advance, or of
advance of symptoms. If signs of improvement have ap-
peared medical treatment will be continued. If symptoms
have merely ceased to advance, the decision will be postponed
to another visit to be made after a short interval, and the
medical treatment will be meanwhile continued. But if the
third alternative has arisen, if the symptoms have become
more marked, then the question of immediate operation arises.

In all of these cases which, at the end of thirty-six hours
from the beginning, show well-marked signs of increasing dis-
ease, the question of an operation should be deliberately and
carefully discussed and in my opinion done. The operation
to be discussed is the one of the removal by laparotomy of
the diseased appendix, the exact condition of which is not
known, but which may cause the death of the patient, either
within a few hours, or within a few days, or perhaps at the end
of a long period by recurrence of disease. These are the
cases whose treatment deserves immediately the closest con-
sideration. It is *not* best to wait for "strong evidence of perfora-
tion, abscess, or general peritonitis." It is *not* satisfactory to
wait until the pulse becomes rapid and weak, and the respira-
tion anxious. What are the signs of "impending perforation?"
No one can name them. When we discover "spreading" peri-
tonitis, peritonitis has already spread. If it has passed beyond
the wall of an abscess then the abscess has already ruptured.
If we wait for marked distension of the abdomen, we shall
often find at operation a septic paresis of the gut, from which
condition I have yet to see a single patient recover. Such in-
dications as these are the very conditions we should endeavor
to *anticipate*, if we wish to save almost all of our cases. By
the end then of thirty-six hours, sometimes much earlier, the
question of operation should be deliberately discussed by the
physician in attendance and the surgeon who would be called
on to operate, if operation were deemed necessary. Surely

the latter can aid in interpreting the indications for or against operation before the time when the former shall have exhausted his medical resources.   As a rule, with but rare exceptions, the indications of advancing disease can be clearly made out by the end of thirty-six hours, provided that the diagnosis has been made early, and that several careful examinations have been made subsequently.   Advancing disease with clear signs at this period should be operated upon.

To be sure, in following such a rule, we shall sometimes operate upon and remove the appendix from a patient who could have recovered without operation and without abscess. This will not often happen.   If it does, we shall have at least, at the same time, cut off the appendix, and the opportunity for a recurrence of disease, perhaps in a very intense form, and under very unfavorable conditions.

Cases which require operation at any earlier period than this are those of very sudden perforation, sometimes with, sometimes without, premonitory signs.   In these cases the intensity of the pain, its very sudden onset, the shock, the marked constitutional disturbance, all point the way to immediate operation.   In some of these, however, shock, even collapse, may be so great, that one is forced to delay, to stimulate the patient, and await at least a beginning reaction. With the late operations this paper does not deal.   They will continue to be numerous, and through our efforts not to be too hasty with surgery, we shall lose some cases by death, and we shall also allow abscess to form which we will open on the sixth, seventh and eighth day.

Such presentation of this subject as I have made very properly requires supporting evidence.   The patient inquires, the physician inquires, and the surgeon asks himself, which is the greater of the two evils, the disease or the remedy?   Not a great many years ago only one answer would have been made to this question.   The removal of the appendix in an acute state of inflammation would probably have failed to save in a larger number of cases than the disease would have killed. To-day this is not so.   The operation is undoubtedly a serious one, but the results of operation have improved vastly, while the disease shows no signs of mitigation.   Not a little miscon-

ception exists in regard to the dangers of the operation. As
affecting the mortality record of surgical interference all of
those cases may be thrown out where surgery has been re-
sorted to to save a patient from a general suppurative peri-
tonitis, from septic paresis of the intestine and multiple ab-
scess in the peritoneal cavity, although even in such cases sur-
gery has sometimes been successful. But we know that these
cases are nearly always hopeless, although we often only dis-
cover this fact when the abdomen is opened. We should not
forget that in the beginning of the disease we usually have to
deal with a patient who was perfectly well up to the first sudden
pain. No exhaustion, no general sepsis, no debility through
long abstinence from food, prolonged vomiting, exist as obsta-
cles to our best efforts. Furthermore, most of our patients
are young, and the majority males. According to Fitz,[4] in
228 cases of appendicitis 173 were below the age of 31 and 207
below the age of 41.

An important and encouraging fact that has not been often
referred to is that although the apparent danger of causing in-
fection of non-affected peritoneum in the course of an opera-
tion for the removal of a diseased appendix is very great, yet
in reality experience has shown this not to be the case. In a
considerable number of these operations done at an early
period, I have found pus present in considerable quantity.
Non-infected portions of peritoneum must necessarily in the
course of such an operation come in contact with sponges,
instruments and fingers, and yet infection of the general cavity
from such a source has not occurred in a single instance. But
I should be doing surgery a gross wrong were I to give the
impression that I considered operations for the removal of the
appendix lightly. It is a serious operation, often a very diffi-
cult one, one requiring general surgical skill, good assistance,
and every antiseptic precaution, and I do not recommend the
operation to one who has never even seen it done, nor do I
recommend it when the requirements such as I have referred
to are not attainable.

A few years ago I felt that we greatly needed actual demon-

[4]Trans. Amer. Physicians, 1886, p. 14.

stration through the results of operation, that the operation could be done by different individuals under varying conditions and with something like uniform success. If such evidence could be accumulated then we could answer the question in regard to the remedy and the disease in favor of the remedy. Such evidence has come to us from various quarters, from Sands, from L. A. Stimson, Weir, Bull, Morton, Senn, Treves, Hartley, Mynter, Dalton, and from many others. And many of these successful operations have been done when the conditions were not of the best, when the cases had been long delayed, for one reason or another not the fault of the surgeon. But I have not been able to analyze and present in proper form the numerous cases referred to, and I must be content with making here my personal contribution to this interesting subject of early laparotomy in appendicitis. By early laparotomy I mean operation before the pathological process has reached a very advanced stage. This cannot be measured by time. In some the rapidity of the process is very marked, in others very slow. Some patients ask for attendance on the first day, and some not until the third or fourth day. I include in my list of cases *all* of the cases treated by early operation in my hospital and private practice before general septic peritonitis had begun, before pus had flowed freely down into the pelvis, or before complete septic paresis of the intestines had set in. These conditions are frequently fatal even with operation, and I am sorry to say that I have had to operate upon a number of such, and without success, although in some of these the operation was done at an early period as regards time, but at a too late one so far as the development of the disease and the surgical indications were concerned.

In studying this subject of *early* laparotomy for appendicitis we must not admit into our statistics operations done at a late period when a well protected abscess, such as can be properly treated by Parker's incision, has formed. From such an abscess of course the appendix may in some cases be extracted. Some such cases I have seen reported as examples of laparotomy for removal of the appendix. The appendix in such cases will generally be taken care of by the process of sup-

puration, as is shown by the usual recovery of patients whose abscesses have been opened and the appendix never seen.

An early operation is an operation done at a time when the removal of an actually diseased appendix is capable of putting an end at once to an active disease which has already become clearly defined and which threatens life.

Of this class of cases I now present to you the results obtained in twenty-four instances. The first of these was operated upon in May, 1888, and the last one week ago, January, 1891.

These include all the cases of this class that I have operated upon up to the present time.

The cases I present are 24 in number; 21 were males and 3 were females; all were under 36 years of age. In all excepting one case the conditions were such that life was seriously threatened. In one case the conditions were such that life did not seem to be threatened by the attack for which operation was done, but the appendix was actively diseased, and a recurrence, if no operation had been done, would have been highly probable. The appendix was completely removed in all cases but two. In one partial removal was deemed sufficient, and in another removal was deemed unwise.

Recovery has occurred in every case excepting one.

Two cases are still under treatment, but are now absolutely safe from accident.

Six cases were operated upon on the second day; 14 on the third day; 2 on the fourth day; and 2 at the end of one week.

CASE I.—E. M. P., male, æt. 19, patient of Dr. F. M. Otis. Great rigidity of right abdominal muscles. Exquisite sensitiveness at point two inches inside of right anterior spinous process of ilium on a line drawn to the umbilicus. At this point small tumor to be felt Pulse rapid and full, temperature, 101°; general appearance excellent. Operation on May 21, 1888, 49 hours from the commencement of attack. Appendix tensely distended with half ounce of foul brown pus. Appendix removed at its base. Recovery without incident of any kind.

CASE II.—John S., æt. 10. Roosevelt Hospital August 19, 1889. Earliest symptoms one week previously. At operation, temperature, 103.4°; pulse, 110; nausea considerable; tender tumor; no tympanitis; small tumor found, consisting of small intestines, enclosing appendix

and a few drachms of pus.   No other adhesions or peritonitis.   Removal easy.   Recovery rapid and complete.

CASE III.—W. K., male, æt. 16. Roosevelt Hospital, July 26, 1889. Abdomen slightly distended and tympanitic; temperature, 102°; pulse, 110; small, very tender tumor. Operation at 49th hour.   Appendix 6¼ inches long, œdematous and much inflamed and thickened.   Minute foci of pus scattered through its substance. No concretion and no perforation.   No protecting deposits of any kind.   Unbroken recovery without incident.

CASE IV.—Annie O., æt. 18.   Roosevelt Hospital, May 30, 1888. History of previous attack 6 years ago.   Tympanites great; small tumor to be felt; temperature, 100.4°; pulse, 100; respiration, 36. Operation on third day.   Appendix found much enlarged, thickened and greatly discolored; a small cavity beneath the end of the appendix contained small quantity (less than one ounce) of pus. The appendix was perforated at its middle by a large fæcal concretion.   Unbroken recovery.

CASE V.—Charles E. A., æt. 25.   Roosevelt Hospital, September 2, 1889. Previous attack five months earlier.   Operation on third day. Severe abdominal pain, nausea, vomiting, muscular rigidity; temperature, 102°; marked adhesions and thickened peritoneum from former attack.   Appendix found with difficulty and removed. It was much inflamed, thickened and hardened; no pus. Easy and complete recovery; small skin abscess.

CASE VI.—Miss E. C., æt. 25, patient of Dr. W. T. Alexander. Prodromal stage of vague discomfort for two weeks.   Severe pain and first disability June 19, 1889.   Great abdominal pain, nausea; pulse, 100; temperature, 101°; patient excessively tender at site of appendix, and looked very ill.   Operation at 24th or 25th hour; scarcely the slightest trace of adhesion; appendix completely gangrenous, and as large as one's middle finger.   It was not perforated, but contained two large fæcal concretions; reddened small intestine lay above and below; two days of nausea and tympanites; after that unbroken recovery.   This operation evidently just succeeded in preventing sepsis.

CASE VII.—Edgar C., æt. 21.   Roosevelt Hospital, January 15, 1889. Initial chill and great pain; temperature, 101.6°; pulse and respiration about normal; right abdominal muscles rigid; very acute tenderness at usual point; no tumor. Operation at 48th hour. Appendix doubled on itself, much thickened and distorted, and containing a black semi-fluid material. It was not perforated; the whole wall of appendix gangrenous at one point, as far as the peritoneal coat.   Unbroken and complete recovery.

CASE VIII.—C. G. McK., æt. 23. First attack two years ago; second attack six months ago; patient haggard and looked ill; an ill-defined tumor existed, and the abdomen was markedly distended. Operation delayed, contrary to advice, twelve hours. Operation October 19, 1889, about 52nd hour. Owing to the distended gut, the search for the appendix was extremely difficult. It was found flat, wide, hard and very firmly bound down in every direction by old adhesions from former attacks. About a drachm of foul pus was found beneath the centre of the appendix. The appendix could be only partially removed, owing to the dense adhesions. No symptoms were relieved. The temperature increased, tympanites became extreme, vomiting set in, and the patient died at the end of four days. My later experience convinces me that this patient died of sepsis; and that the tympanites was due to septic paresis of the intestine, a condition which had begun some time before the operation. Had an operation been done at the first attack probably no such difficulties as I encountered would have been met with.

CASE IX.—T. R. D., male, æt. 22. Roosevelt Hospital, July 4, 1890. Very severe abdominal pain before admission, also occasional vomiting. On admission, temperature, 99.6°; pulse, 102; severe pain in right iliac fossa; extreme tenderness at typical situation. Operation at about middle of third day. Some slight adhesions between intestinal folds. The appendix is found coiled on itself, very deeply placed, and containing several fæcal concretions. It was perforated in two places at its base, and beneath this portion was a small abscess. The appendix was ligated and totally removed. Recovery unbroken and complete.

CASE X.—Edgar C. B., æt. 21. Roosevelt Hospital, January 15, 1889. Severe general abdominal pain, followed by chill. Temperature, 101.6°; pulse and respiration good; general appearance excellent; characteristic extreme tenderness on pressure on base of appendix. Operation at 50th hour. Appendix found behind and inside of cœcum, and doubled on itself. Its removal was difficult. The mucous membrane was gangrenous, and at one point the gangrene involved the whole structure of the organ to the peritoneum. No concretion. Recovery unbroken and complete.

CASE XI.—T. H., male, æt. 23, patient of Dr. Chas. Hunter. Extreme and continued abdominal pain; temperature, 99°; pulse, good; points of extreme tenderness characteristic; considerable distension. Patient had received 1½ grains of morphine in 24 hours. Appendix found without difficulty. It was but little enlarged; peritoneum not in

the least inflamed; no adhesions. The appendix contained six small concretions. Recovery unbroken and complete.

CASE XII.—Charles H., æt. 26. Roosevelt Hospital, May 30, 1889. History of four attacks; severe abdominal pain, chill and vomiting; very tender tumor; temperature, 99.4°. Operation May 30, at end of one week from first symptoms. Appendix found firmly tied down by old adhesions. It was removed, and found to be soft, swollen and infiltrated throughout with small foci of pus. Recovery unbroken and complete.

CASE XIII.—John C., æt. 28. Roosevelt Hospital, March 22, 1890. Prodromal stage of nearly two weeks of slight pain and abdominal discomfort. On admission, great pain and tenderness on pressure at the usual characteristic point; small, deep, movable tumor; pulse, 90; temperature, 99°. Operation on third day. The appendix was with difficulty dissected away from adherent intestine. This operation opened a small abscess; only about two inches of appendix removed; some fever for two days after operation. Otherwise recovery unbroken, though slow.

CASE XIV.—S. T , male, æt. 15. Roosevelt Hospital, December 13, 1889. Pain and tenderness in right iliac fossa; extreme point of tenderness on pressure lower than usual; small tumor, no tympanites and no fever. Operation on fourth day. Appendix easily found and removed; no adhesions; much swollen and necrotic at distal extremity. Perforation nearly complete; no pus. Recovery unbroken and complete.

CASE XV.—Mary D , æt. 13. Roosevelt Hospital, December 23. Severe pain and nausea, with occasional remissions for three days; characteristic tenderness on pressure at usual point; small tumor to be felt. Operation on third day. No adhesions excepting at apex of appendix. This organ was much thickened and hard, and the mucous membrane swollen and pulpy. Recovery rapid and complete. This patient would probably have recovered under medical treatment.

CASE XVI.—C. E. A., male, æt. 25. Roosevelt Hospital, September 2, 1888. History of former attack six months ago; tells the story of a long-continued illness. Present attack began two days ago; severe abdominal pains, nausea. and high fever. On admission, tenderness all over right iliac fossa, and tense muscles; temperature, 102°. Operation on third day. A very difficult dissection, owing to old adhesions of an extensive character, ended in the discovery of the appendix at a deep point on the edge of the pelvis. It was short, thick and densely hard; no pus existed. Recovery a little troublesome, but complete in six weeks.

CASE XVII.—Wm. S , æt. 56. Roosevelt Hospital, November 19, 1889. Great abdominal pain ; temperature not recorded ; pulse quick and full ; characteristic tenderness at usual point extreme ; tympanites great; operation on the third day. Appendix found very deeply placed behind and inside of the caput coli. At its base was a small, very distinct abscess, containing about two drachms of pus. Intestine in and around the abscess free, and not adherent anywhere. The appendix was much broken down and imperfect ; removal partial ; recovery easy, but a long tedious fistula remained, which was not closed until June following, otherwise his health was perfect.

CASE XVIII.—E. P. L., male, æt. 21. Patient of Dr. Charles Scudder. Sudden onset of great abdominal pain ; nausea very early ; temperature 102° ; pulse full and bounding ; exquisite tenderness on pressure over base of appendix. Operation February 27, 1890, at about 48th hour. Appendix very large, gangrene throughout and soft and putrid ; passed deeply down to and over edge of pelvis ; no adhesions ; marked inflations of intestines and the adjoining coils deeply reddened ; no concretion ; removal not difficult ; unbroken recovery. rapid and complete. Only incident troublesome tympanites for three days.

CASE XIX —Henry B., æt. 16. Patient of Drs. George S. Wheatlock and W. W. Hewlett. History of three previous attacks of severity ; each occurred in a different country and on two occasions the temperature in attacks reached 104°. Fourth attack began at noon June 30, 1890. Very severe onset with pain and vomiting ; high fever at once after chill. Operation at the 46th hour. Pulse 120 ; temperature 102.5°. Appendix short, hard and much altered ; black at points, not perforated ; respiration hurried.

Some old and very tough adhesions existed, but no recent ones. A wide open hollow by side of appendix held about two drachms of fœtid pus. If the boy had turned over in bed he would have poured this pus into the general cavity. Appendix completely removed, but with difficulty. Temperature continued high for two days. Constipation was troublesome, after that complete and easy recovery.

CASE XX.—E. S. H., male, æt. 35. Patient of Dr. F. Hewel. Sudden onset, but symptoms not intense ; complete disability. Operation on the third day. Pulse moderate but feverish ; temperature 101.5° ; characteristic tenderness on pressure highly developed ; small tumor ; appendix much diseased, partly gangrenous and perforated very slightly by fæcal concretions, containing four bird shot. Very few binding adhesions ; about one drachm of pus beside the appendix. Operation easy ; recovery unbroken and complete.

Case XXI.—W. W., male, æt 23.   Patient of Dr. B. C. McIntyre. History of serious attacks in the four years, each more severe than the last.   Present attack began with epigastric pain, chill and vomiting, November 20, 1890.   Operation at the end of the third day. Very ill look ; small tumor ; characteristic tenderness very marked. Temperature only 99 2°; small tumor very deep, behind and inside caput coli ; fresh and old adhesions at this point only enclosing the appendix and the pus.   The abscess was opened and the appendix rec ognized with the finger, but it was too much altered and bound down to justify removal.   Recover easy and complete, excepting that a sinus is still open, otherwise health and comfort perfect.

Case XXII.—A. B. O., male, æt. 35.   Roosevelt Hospital, January 28, 1891.   History of previous mild attack few months ago.   Present attack began with sudden and severe pain in the right iliac fossa ; this continued constantly.   Operation middle of third day.   Temperature 99.8°; pulse 80 and full ; general look excellent ; exquisite tenderness on pressure one-half inch below usual point ; very small tumor to be felt.   Appendix found doubled on itself, large, hard and much in flamed ; it was quite concealed by recent plastic deposit ; no pus ; mucous membrane black and pulpy .   Removal easy ; convalescence perfect ; still under treatment.

Case XXIII.—C. O., male, æt 12. Roosevelt Hospital, January 1, 1891.   Sudden onset ; very great abdominal pain ; vomiting ; no chill. Operation middle of fourth day   Characteristic tenderness very marked at usual situation, but over a larger area. Small tumor. Temperature 101 6°. Appendix found in small cavity formed by small intestine alone and containing a few drops of pus.   Appendix bent upon itself and perforated by fæcal concretion   Partly gangrenous ; removal difficut but complete.   On third day lobar pneumonia ; convalescence good, however, and wound to-day nearly healed.

Case XXIV.—G. B , male, æt 16.   Patient of Dr. S A Spalding. Sudden attack: high fever and pulse; local signs very marked; general appearance excellent. Operation at 40th hour.   Appendix much diseased, contained two large concretions ; it was not perforated.   Recovery rapid and complete.

THE INDICATIONS FOR EARLY LAPAROTOMY IN APPENDICITIS.[1]

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IN this brief paper I shall have no opportunity of entering into a relation of cases, or of alluding to the technique or to other details, but shall immediately pass to the topic assigned me.

I am glad that the Committee have selected the name "Appendicitis" rather than the formerly more common "perityphlitis," for there is no doubt that Fitz is quite right in claiming that "every case of so-called perityphlitic abscess must be regarded as primarily one of perforative appendicitis, unless proved to be the contrary," and McBurney is right in estimating that perityphlitis as compared to appendicitis exists in not more than the proportion of one to one hundred. Not that cases of properly so-called perityphlitis do not exist, but that the form which we are to discuss at the present time, namely, an abscess in the right iliac fossa, as well as many other cases without abscess, almost always arise from appendicitis, and most frequently, perforative appendicitis.

Matterstock found perforation in 132 out of 146 autopsies where there was suppuration, Fenwick, 113 out of 125, Weir, 34 out of 100, and Kümmel places his percentage at 100. Hence I think the prominence that has been given of late to the appendix rather than to the cæcum is amply justified by the facts.

[1]Read before the New York State Medical Society, February, 1891.

For clinical purposes *five forms* of appendicitis may be recognized.

First, a mild form of appendicitis without perforation, ending usually in resolution without the formation of an abscess.

Second, perforative appendicitis, followed by general peritonitis. This form appears in two different modes: (*a*) a severe, early and often fulminating peritonitis, and (*b*), a form which is apparently mild, and, after continuing so for a certain length of time, suddenly bursts out into a disastrous general peritonitis, either from perforation of the appendix or rupture of an abscess which sometimes has not even been recognized.

Third, the most common form, in which the appendix is perforated and a local, and, as McBurney has happily called it, a "comparatively safe" or "comfortable" abscess forms more or less rapidly, and either is operated on or ruptures externally or into a hollow viscus, and finally ends either in resolution or death, usually within two, three or four weeks. Occasionally by the rupture of the abscesss into the general cavity of the peritoneum this form is suddenly transferred to the preceding class.

Fourth, a class in which the abscess forms slowly and follows a chronic course, lasting for not only weeks, but even months, and it may be a year, before it either discharges or is operated on.

Fifth, recurrent appendicitis in which attack follows attack at longer or shorter intervals, until finally the last attack kills, especially if not operated on, or the patient may, perchance, recover. From the very nature of the topic assigned me "Indications for Early Laparotomy," the last two forms are excluded from this discussion except incidentally.

First, the mild form of appendicitis. That this is frequent is proved abundantly by the statistics of Tofft, Hektoen and Fitz; so frequent, indeed, that we must assume that nearly one-third of all adults have had one or more attacks. Most of them have been overlooked, perhaps, for in most cases that I have seen the attack has been deemed by the patient to be one of simple indigestion, or of colic, or of some other similar and common intestinal disorder. This very frequency has been urged by some as a reason for frequent operative interference.

To my mind it argues precisely the reverse. If one-third of all post-mortems of adults give evidences of appendicitis recovered from without abscess and without operation, it is to my mind the strongest reason why we should, on general principles, deem that an operation in this class of cases is by no means often to be done. But it is especially to be observed that these attacks which have been recovered from by medical means alone have been of a mild form, and have usually been unrecognized as appendicitis except on the post-mortem table. We may, therefore, dismiss this class of cases as not requiring any operation, save in exceptional cases.

Second. Precisely the contrary may be said of the next class, of which every case demands instant laparotomy; namely, those cases of perforative appendicitis which are followed by general peritonitis, often in such a fulminating form that life is destroyed, even in the course of twelve to twenty-four hours. Such a form as this is usually easily diagnosticated, and the indications are so clear that they cannot be mistaken by any well-informed physician or surgeon. Unfortunately in too many of the cases the need for instant laparotomy is so urgent that it is impossible for the physician to call the surgeon in consultation, and for the latter to make the necessary preparations as to assistants, dressings, etc., before the patient is almost past hope. No cases in surgery, saving, perhaps, hæmorrhage from large wounded vessels, require more prompt interference, and even then with comparatively little hope of rescuing the patient. The indications for instant laparotomy are: Brief symptoms of recent appendicitis, or of one or more recurrent attacks, followed by sudden excruciating pain all over the abdomen, but most severe in the right iliac fossa, with the familiar picture of general peritonitis and impending collapse.

Sometimes, however, instead of this acute course from primary perforation the case will apparently first belong to the category of milder cases, requiring no operation. The patient is seemingly doing well, has but slight fever, moderate pain and tenderness, and but little tumefaction. He may even be improving, and the fears of the physician may have been lulled by the apparent security which makes the awakening the more

startling. In spite of the deceptive mildness of the attack ul-
ceration has gone on insidiously till perforation, or in many
cases gangrene of the appendix, has occurred.[2]

Some, if not many, of these cases must go on, unrecognized
even by the most careful observers, but I earnestly believe
that operation is rightly undertaken when there is persistent
pain and tenderness, especially at McBurney's point, with even
slightly increased resistance without any tumor, with possibly a
slight œdema and a moderate fever. An exploratory opera-
tion in careful hands with modern antiseptic methods has
comparatively little risk and I believe this risk will result
in fewer deaths by far than will the expectant delay which has
been generally heretofore the rule. Show me a case operated
on in which the operation was a mistake and for every one, ten
can be shown in which the Fabian policy of waiting for the
signs of tumor or of peritonitis was fatal. Even if the oper-
ation was unnecessary and, therefore, a mistake it will rarely
cost a life, but the opposite mistake is nearly always fatal.

Most commonly, however, I believe these cases belong at
first to the next class, in which an abscess, not perhaps of large
size, has really formed, and, not having been recognized and
operated upon, it has suddenly burst into the peritoneal cavity.
In many instances again it is impossible to distinguish between
those cases which will run a continuously mild course and ter-
minate in resolution and the apparently mild cases which run
a nearly parallel course, but which are accompanied by abscess
and finally burst into such fatal fierceness.

But I believe it is not impossible, by minute and careful ob-
servation of the points to which attention is called in the next
class, to be able in general to determine whether an abscess
has formed, especially by the most minute and delicate palpa-
tion, sometimes by rectal and vaginal examination; often by
the possible overlying œdema; and generally by the tender-
ness at McBurney's point, in addition to the general constitu-
tional symptoms. The general constitutional symptoms, it

[2] I believe there has been no bacteriological examination of the contents of the
unruptured but catarrhal or ulcerated appendix. It is greatly to be desired that
such should be made and the nature of the contained micro-organisms be asce
tained.

can scarcely be too strongly insisted on, are far inferior to the local signs in forming an accurate diagnosis. Even the temperature, so commonly a reliable guide, may be most deceptive, for the lesion is distinctly local in its chief activity and the body heat is usually only moderately elevated and may subside while the local process is absolutely progressing toward a most dangerous or a fatal issue.[3] The only general symptom of especial value is severe pain arising, as has been pointed out by Stimson, not as an initial symptom, when it is often severe, even in otherwise mild cases, but arising more or less suddenly in the course of the attack. This very pain itself may be more justly called a local than a general symptom.

I would lay it down as a rule, therefore, that even in mild cases, and in cases that are apparently convalescing, if the indications point even slightly toward pus an early operation should be done. If pus is present the propriety of an operation, I am sure, will be denied by no one, and if it is absent a simple exploratory operation with all the precautions of modern antiseptic surgery is so far from being dangerous that no patient should be allowed to run the risk of a probable or possible rupture and general peritonitis. An exploratory operation "carries with it less danger than the disease." The same challenge just made above may be confidently repeated.

That such apparently mild disease may be seemingly progressing toward recovery, and yet imperatively demand an operation, is well seen in a case reported by me in the *Medical and Surgical Reporter*, so long ago as February 6, 1886, page 165, which was as usual regarded by the patient at first as an ordinary colic. When I saw him on the sixth day his temperature, which had been 102.4°, had fallen on the fourth day, and on the sixth day was only 99.4°. The pulse was only 88, legs extended, belly not markedly tender. The pain had almost disappeared, so that he was comfortable, could turn in bed and

[3]Since this paper was read I have operated in the Jefferson College Clinic on a young man, ninety-two hours after the beginning of the attack with moving temperature of only 99°, and yet an inch of the appendix was falling into gangrene around a large fæcal concretion, and a half pint of fetid serum and flakes of fibrinous exudate were discharged from the right iliac fossa. He is recovering without a bad symptom.

use his right leg without suffering. No fluctuation could be detected and deep pressure produced but little pain, but there was considerable œdema, and an operation revealed an abscess containing nearly a pint of fetid pus. Moreover, we must remember that peritonitis and death may occur even without either gangrene, perforation or a local abscess.

The third class of cases, however, is that which most frequently comes under the eye of the surgeon. They occupy a middle place between the mild form, so often overlooked, and the acute form of general peritonitis. Even in this class the symptoms are not seldom latent and may escape notice unless the physician is on the alert and has been forewarned of the possibility of appendicitis, either by such a discussion as the present one, or by his reading, or it may be by sad experience.

Usually there will be more or less pain, commonly quite severe. This pain is often not at first located in the right iliac fossa, but may be over the whole abdomen, in the epigastrium, the hypogastrium or even the left iliac fossa. In time, however, though it maý persist elsewhere it generally becomes most severe in the right iliac fossa. Dr. McBurney has done a good service in pointing out that tenderness to pressure is especially marked at a point "an inch and a half to two inches from the anterior superior spine on a straight line toward the umbilicus," and it is best determined by pressure with the tip of one finger. Sometimes the tender point is a little lower than the line. It is often best indicated by the patient himself. With this pain will usually go nausea, vomiting (not stercoraceous) and constipation. The fever will be marked but rather moderate, rarely over 103° and more commonly in the neighborhood of 101° or 102°. Dullness on superficial percussion not seldom may be absent by reason of interposing coils of intestine. Deep percussion may, however, show diminished resonance and even dullness; and a delicate touch may discover increased resistance, and this physical sign as well as the dullness may be marked. Both of these signs are generally best marked under ether. Even when a large abscess is present I have never been able distinctly to discover fluctuation and I place no reliance whatever on the absence o

this sign. A sign which has been too much neglected I think is the œdema which is so commonly seen overlying a deep abscess. If the right iliac fossa be doughy with œdema I believe it is almost always a reliable sign of suppuration.[*]

Moreover, pus will be present much earlier than was formerly supposed to be probable and, therefore, an operation should be done much earlier than we formerly believed to be wise. Willard Parker, in 1867, was the first to compel the profession to hear him, and recommended that an operation should be done between the fifth and twelfth day. With increasing experience and, especially in the light of better results from earlier operations, last year Fitz expressed the view that the third day was not too early. When we remember that these cases arise from abscess, produced either by extensive inflammation of the appendix, or far more commonly from gangrene or from perforation; that such perforation will instantly light up a sharp local peritonitis limited by the agglutination of the neighboring coils of intestine, and that common experience shows that even in connective tissue, as, for instance, from a felon or a boil, pus readily forms in 48 to 72 hours, we must expect that in the peritoneal cavity pus will form at least as early. This presumption has been turned to certainty by a number of recently reported cases. The limit set by Fitz then does not seem unreasonable. Even as much as three pints of pus have been found by the fifth day. This large quantity would require certainly two to three days for its accumulation after suppuration had begun.

To establish the existence of pus I was formerly inclined to use the hypodermatic syringe, but a larger experience has convinced me that an exploratory operation is much more certain and also much less dangerous than the needle. The disease it must be remembered is apt to prove fatal at an early date. In the 176 cases collected by Fitz 68% died in the first 8 days and two-thirds of these between the fourth and eighth days.

[*]Several times I have noticed this œdema in the layers of the connective tissue between the muscles, even if absent under the skin. Its existance is of great value as a positive indication of pus at a lower level.

I should, therefore, formulate a general rule that by the second, certainly by the third day, and *a fortiori* later, the operation should be done if the following indications are present:

First, if there is abdominal pain, most marked in the right iliac fossa and especially with tenderness at McBurney's point, attended possibly with nausea and vomiting. Secondly, if there is rigidity of the right abdominal wall. Thirdly, if there is fever up to 100°, 101° or 102°, which does not yield to medical treatment. Fourthly, if by minute and careful palpation tumefaction and increased resistance can be discovered, with possible dulness and rarely fluctuation; and fifthly, if there is œdema of the abdominal wall.

Pus will generally be found, but it is possible that there may be none. If pus is present the abscess cavity is to be evacuated and washed out with great care, lest its frail wall be broken down and general peritonitis ensue. If there be no pus the appendix should be sought and if, as will I believe almost uniformly be the case, it is swollen, thickened, distended the seat of a concretion or otherwise abnormal, even without perforation, it should be tied and cut off and the stump either be simply disinfected, or, as I prefer, inverted and covered by a few Lembert stitches through the outer layers of cæcum.

The brilliant results which have been reported by Senn, Treves, McBurney, Stimson, Bernardy, Baldy and others, in cases in which no pus was present but the appendix was perilously diseased, have abundantly shown that such an appendix is a menace to life compared with which the dangers of an aseptic operation are nothing. Moreover, I should be decidedly in favor of an operation even if there were present only iliac pain, tenderness at McBurney's point, rigidity of the abdominal wall, moderate fever and increased resistance without tumefaction and dulness, nausea and vomiting. The unusually large personal experience of Fitz shows that five-eighths of all cases and one-fourth of the cases which had been treated medically alone should have been operated on. With so large an experience from so careful and accomplished an observer, it is a crime for us to go on allowing case after case to die that ought to have been relieved by surgical interference.

I cannot close this paper without calling special attention to

what I believe is a most important point in connection with appendicitis, and it is especially appropriate to so large and influential a body as this, composed both of physicians and surgeons from all parts of the Empire State. The warning has already been sounded but it cannot be too strongly insisted upon that in every case of suspected or proved appendicitis or perityphlitis a surgeon should be called in consultation *at the outset.* If called later when an emergency has arisen and there is need for surgical interference, if the need be absolute, it is of course evident that the surgeon will immediately operate. But in the great majority of cases he will necessarily be tempted to be cautious and conservative, desiring greater familiarity with the details of the case, and to postpone any operative interference, at least for one or two days, too often a fatal delay. This is neither fair to the surgeon nor to the patient. The need for familiarity with the case on the part of the surgeon, and the right of the patient to have the very best time selected for the operation, demand that the surgeon should be called in consultation early in the case, that he should be familiar with it from repeated visits, and should be ready instantly to seize the favorable moment for operation. It must not be thought that any conscientious man, because he is called in as a surgeon, will wish immediately to operate ; but it is his right, and it is also the right of the patient, that the surgeon, in order to be able to determine this momentous question wisely, should have the entire course of the disease at his fingers' ends by frequent personal observation, rather than by information filtered all at one time through the mind of the physician.

Confessedly many cases are doubtful and require the most careful weighing of the evidence for and against operative procedure. The surgeon who has attended the case in consultation with the physician from the outset, and the physician who all along has had the benefit of the surgical advice of a colleague, will both be far better fitted to cope with any sudden emergency and both will be far more likely to select the wisest time for the operation. The very first "indication for early laparotomy in appendicitis," therefore, is to call in the surgeon early.

THE TECHNIQUE OF OPERATIONS FOR THE RELIEF OF APPENDICITIS.

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IN DISCUSSING the technique of operations for the relief of appendicitis it will be desirable separately to consider those in which the operation is begun by the making of a free opening into the general peritoneal cavity and those in which it is limited to the evacuation of the contents of an abscess of considerable size without such exposure of the peritoneum. In the first group are included those operations that are done in a period of quiescence after recurrent attacks, those done in the early stage of a progressive attack, with or without abscess or general peritonitis, and those in the later stage when the abscess has formed in one of the rarer positions and is not adherent to the anterior wall of the abdomen; the second group is composed of those operations that are done in a late stage of the affection for the simple evacuation of an abscess that can be reached without exposure of the uninvolved peritoneum, either by an incision directly into it through the anterior abdominal wall or by a more indirect route along the floor of the iliac fossa, or through the rectum.

First Group.—As it is not always easy to recognize in advance the position or condition of the appendix, the presence or absence of pus, or the position and relations of the abscess if one is present, the operation cannot be ordered in all its details from the beginning, but the surgeon must be prepared to follow at any moment the operative indications that arise as he advances. This fact creates some embarrassment in the

preparation of a formal description. The plan here adopted is to describe, first, the general method with the details employed in the simple forms, and then to give the variations in procedure which may be made necessary by varying conditions. I shall therefore first describe the steps taken in the removal of an appendix in the early stage of its inflammation or in a period of quiescence after recurrent attacks, and then indicate the steps made necessary by the presence of pus in small or large amount, or by the exceptional position of the abscess or composition of its wall.

In addition to the instruments and appliances habitually prepared for use in all major operations, the surgeon needs an aneurism needle charged with stout catgut, two retractors, the blades of which, bent at a right angle to the handle, are about 3 inches long and $1^1/_2$ inches wide, several large flat sponges, and a dozen napkins not too thick. The sponge and napkins, after efficient disinfection or sterilization, should be kept in hot water that has been thoroughly boiled. The number of the sponges, flat and small, should be noted. An abundance of hot and cold boiled water, warm antiseptic solutions, and towels must be provided.

If time has permitted, the abdomen of the patient should have been prepared by several hours' contact with a layer of green soap, followed, after washing, by a dressing of compresses thoroughly wet with a bichloride solution.

After anæsthetization, the patient is placed upon his back on a high narrow table, his lower limbs and chest wrapped in blankets, the abdomen left exposed. Rubber sheets are placed over the blankets and turned under at the edges adjoining the abdomen. The abdomen is then shaved, scrubbed with soap and water, washed off with water, than with alcohol or ether, and then with a 1-1000 bichloride solution. The rubbers are then widely covered with towels wrung out in the strong bichloride solution, and another towel is placed on each side so as to leave only the right half of the abdomen exposed.

In selecting the site of the incision the choice lies between the median line below the umbilicus, and the outer margin of the right rectus abdominis muscle at about the same level. The latter is the one habitually chosen for the early operation,

the former being reserved for cases of doubtful diagnosis or for special indications. The reasons for this preference for the lateral incision are very strong; it lies directly over the root of the appendix, it exposes the probable field of operation much more favorably than the other, and it creates a shorter and less exposed line of drainage. Certain advantages that have been urged in favor of the median incision appear to me to be inadequate to change the preference; they are: the greater probability of not encountering adhesions between the anterior wall and the intestines in the line of the incision, and the easier access to all parts of the peritoneal cavity for washing and drainage. The first mentioned advantage can be readily equaled at the other site by extending the incision upward if necessary; the second is rarely required, and such washing is, moreover, as will be subsequently explained, of doubtful value. If the existence of general peritonitis should indicate it, a second median incision can be subsequently made. The oblique incision (which will be described in the second group) is strongly recommended by Reclus, following Roux, but in making this recommendation he appears to have had in mind only cases of well-developed abscess, and mainly those adherent to the anterior wall. It is to be remembered that operation in the early stage or for recurrence, if not of exclusively American origin, has at least been developed and established by American experience, and that such development is still so recent that we have not yet had time to receive from abroad the results of much experience in, or study of, the subject by others.

Beginning at a point corresponding to the outer edge of the right rectus abdominis at or a little above the level of the umbilicus, the surgeon, standing at the right side of the patient, makes an incision through the skin and subcutaneous tissue directly downward for four or five inches, and then divides the aponeurosis of the external oblique for nearly the some distance. After having arrested the bleeding, he seeks the lateral edge of the rectus and divides the fascia beneath it. The peritoneum is next picked up with forceps in the upper part of the incision and opened, and the opening enlarged downward with the scissors or knife guarded by two fingers of

the left hand, care being taken to avoid the deep epigastric artery and vein which can be readily felt a little to the inner side of the lower part of the incision by the finger in the cavity. The layer of tissue overlying the peritoneum may be œdematous, but this is not a proof either of the presence of pus or of adhesions between the viscera and the abdominal wall. The upper portion of the incision is chosen for the opening of the peritoneum because it is there less likely to be adherent to the underlying omentum or intestines; if, however, it should appear to be adherent to them, that is, if it should be thickened and if it cannot be pinched up and clearly separated from them, the incision should be extended upward until a point is reached where the opening can be safely made.

The small intestines are then pressed upward and toward the median line, and held back with the flat sponges and folded napkins supported by the large retractors or the fingers of the assistant. If the appendix is not now visible, the operator raises the cæcum and seeks it behind the latter. If it is found to be free and with only its normal attachments, he raises it, passes the aneurism needle armed with a double catgut ligature through its mesentery close to its base, cuts the ligature in two, ties one piece about the mesentery, the other about the appendix, and divides the mesentery with scissors from its free edge back to the opening through which the ligatures were passed. He then presses two small sponges on handles close down about the root of the appendix to receive whatever may escape from it when it is divided, and cuts it away with scissors close to the ligature. The sponges being still held steadily in place, he sears the mucosa of the stump of the appendix with pure carbolic acid applied by means of a small pledget of cotton wrapped about the end of a probe, or with the Paquelin cautery.

This method of treating the stump has been employed in a large number of cases, and with uniformly satisfactory results, and it is, I think, to be unhesitatingly preferred to another that has been occasionally employed, that of not using a ligature, but turning in the cut end and suturing its opposing serous surfaces. The latter, even when it can be employed, certainly requires more time and is more difficult of execution,

and probably less safe; but, what is still more important, in most cases it is made practically impossible by inflammatory changes in the peritoneum and the sub-peritoneal tissue which are so swollen and infiltrated that it seems hardly possible that the procedure could be seriously contemplated by anyone who had occasion to deal with the appendix in such a condition. Furthermore, there is always the possibility that the small stump of the appendix thus left may include the original stricture or total obliteration of its lumen which gave rise to the process, and the operation leaves the patient as liable to a recurrence as if nothing had been done.   The conjoint use of both methods, that is, the turning-in of the divided end and the placing of a ligature between it and the cæcum, as has been proposed, seems to me to combine with unfortunate thoroughness such disadvantages as may pertain to each, and to add thereto a dangerous one of its own, namely, the formation of a closed pouch with a suppurating and infected surface, which may be trusted, with considerable confidence, to produce a dangerous abscess ready to rupture and spread after the removal of the drainage tube and the closure of the external wound have made such a complication peculiarly perilous.

If the appendix is unrecognizable because of adhesions formed in previous attacks, it must be sought for by palpation of the thickened mass that may be felt behind the cæcum or along the mesentery of the terminal portion of the ileum.   A valuable guide to the base of the appendix is to be found in the longitudinal bundle of unstriped muscle on the anterior aspect of the ascending colon which terminates inferiorly at the origin of the appendix.   Embryology has taught us that the appendix is the original cæcum, the primary extension of the colon beyond the ileo-cæcal junction, and that the cæcum as we know it in the individual is a pouch subsequently formed on the outer aspect of the colon; consequently, the longitudinal bundles of the colon continue into the appendix, and the anterior one, which is in plain sight usually, leads directly to it.

The appendix having been found, it is freed from its adhesions by gently tearing them with a blunt instrument or by

cutting them when they are sufficiently thick and well-defined to make this desirable and free from the risk of accidentally wounding the intestine. It may sometimes be advisable to ligate these adhesions before dividing them, but I think this is rarely necessary. The apex of the appendix is sometimes firmly united to the floor of the iliac fossa by a cord that contains a small artery, and it is well to tie it before cutting it.

When the operation is done in the early stage of an attack a small quantity of pus may be found, either lying free in the fossa behind or on the outer side of the cæcum, or shut in by slight adhesions; in the latter case the traction made in lifting the cæcum or the appendix will usually cause the pus promptly to appear. It should be caught on a sponge as it flows, and the spot from which it came should be thoroughly wiped out and washed with a small amount of the strong bichloride solution before proceeding to the removal of the appendix.

If the operation is done at a somewhat later stage, and the appendix is unrecognizable because it is imbedded in and forms part of the wall of the abscess, it seems advisable, in the present state of our knowledge, not to attempt its removal, but to be content with the evacuation and drainage of the abscess.

The abscess may form behind the lower part of the ascending colon, apparently between the layers of the mesocolon, and may extend as far upward as the flank; in such case a small opening should be made into it at its lower end, after complete protection of the neighboring intestines with flat sponges and napkins, and the pus removed on sponges. In some cases it may be desirable to make a counter-opening for drainage in the flank just above the crest of the ilium, cutting from without inward upon the finger or a large blunt instrument as a guide.

If the abscess extends far down in the true pelvis a counter-opening may be made through the rectum, and the drainage tube brought out through the anus.

In the non-suppurative cases no cleaning of the peritoneal cavity is required, except the wiping out of such blood as may have escaped the protecting sponges. It is in my judgment

very much better that not only blood but also pus should be removed by sponges rather than by flushing the cavity with water; the latter plan may have its advantages under certain conditions, as, for example, when the pus is present in large amount and so widely distributed that its removal by sponging is impracticable; under such circumstances a stream of water carried by a long glass tube $\frac{1}{2}$ or $\frac{3}{4}$ inch in diameter to the furthest recesses of the peritoneal cavity will rapidly remove the greater part of the pus and leave in its place water thinly mixed with pus that can be more readily absorbed than the undiluted pus which it replaces. But as a method of cleansing, in any other sense, such flushing of the cavity is illusory; one has only to reflect on the impossibility of effectually cleaning with soap and water and a brush his infected hands to realize that such flushing of a cavity cannot fail to leave its wall still covered with the agents and products of infection.[1] Sponging is of course equally ineffectual, but it has the advantage of being more rapidly and easily done, and is free from the disadvantage which experiment has shown may be associated with such contact of water with the uninvolved peritoneum.

Experience has abundantly shown that entire removal of the pus and complete disinfection of the cavity occupied by it are not essential to recovery; on the contrary, the observation is constantly made that not only do patients with peritoneal abscesses habitually recover without unfavorable incidents, but also that even the parietal incision frequently heals without suppuration although its surface may have been bathed in the pus of the abscess. It is evident that absolute disinfection of the abscess-cavity is not essential, and that the protective measures commonly employed are sufficient to secure the patient against the occurrence of an infectious general peritonitis during the drainage of the abscess across a portion of the peritoneal cavity. This experience, in my judgment, disposes of the ingenious plan of a preliminary median incision suggested by Dr. Gerster, to enable us to ascertain whether an abscess may not be adherent to the anterior abdominal wall at

[1] As a recent writer in the Archiv f. klin. Chir. has put it; "Spülerei ist Spielerei;" rinsing is ridiculous.

some point, and, if such adherence is found, to evacuate its contents without exposure of the general cavity. The abandonment of the removal of the appendix which that method, if closely adhered to, involves, appears to me fully to offset the reduction of the immediate risk.

Very exceptionally, the abscess may be found, not in contact with the floor of the iliac fossa, but imbedded among loops of intestines which wholly, or almost wholly, surround it and separate it from the abdominal parietes at all points. In such a case it lies nearer to, and perhaps crosses, the median line, extending into or hanging down in the true pelvis and is separated from the outer part of Poupart's ligament and the anterior superior spine of the ilium by a distinct interval that is easily recognized before the abdomen has been opened; the covering loops are also more or less extensively and firmly adherent to the anterior abdominal wall or omentum. Such a condition is more difficult to deal with than when the abscess is in the usual position, for the safest route to and outlet for the pus is not so clear, and the difficulty of drainage and chance of infection are greater. The identity of the component elements of the abscess-wall is unrecognizable amid the adhesions that bind them together and the false membranes that cover them, and the surgeon must blindly grope his way toward the abscess, feeling for points of softness or of least resistance, and gently tearing the adhesions with his fingers. In this search the finger seems to me to be better than any instrument because of the information and warnings constantly received through it. When the pus is reached it must be caught and removed as in the other cases.

It may happen in the suppurative cases that the appendix is indistinguishable amid the adhesions, and that it is inadvisable to seek for it with a view to its removal, lest in the search a loop of intestine should be torn or protective adhesions should be ruptured and a possibility of infection incurred which would not be compensated for by the removal of the appendix. It seems to me to be more judicious simply to empty the abscess and to trust to the obliteration of the appendix by the suppurative process.

If no pus has been found, and no infection has taken place

during the division and removal of the appendix, the abdominal incision may be entirely closed without drainage. The two methods of closing it which are widely used in abdominal section for other affections may also be employed here: either a single row of silk or silver sutures embracing the entire thickness of the abdominal wall, or separate union of the different layers with buried sutures of catgut; in the latter method a continuous suture is to be preferred for the peritoneum, and interrupted sutures for the other layers; or, after closure of the peritoneum, a single set of silver, silk, or silkworm sutures may be used for the remaining layers.

If pus has been found or if infection has taken place, drainage must be used, and with it plentiful packing of the abdominal cavity between the incision and the abscess with iodoform gauze. The value of this measure has been abundantly shown, both in appendicitis and in other affections complicated by the presence of pus, hæmorrhage, or infection. A rubber drainage tube is passed down to the stump of the appendix and surrounded with a loose packing of gauze; if the circumstances call for it (contact of pus with free loops of intestines; prolonged exposure and handling) other strips of gauze should be packed among the adjoining loops of intestines and between them and the abdominal wall adjoining the incision. The incision itself I prefer to close in part, certainly at its upper end, and sometimes also by a suture midway of the portion left open; others prefer to leave it entirely open and to close it with secondary sutures after removal of the tube and packing. My practice has been to withdraw the packing placed among the loops of intestine quite promptly—on the first or second day after the operation—and perhaps also to remove at the same time a portion of that packed about the tube. The remainder of the latter and the tube should also be removed as promptly as circumstances will warrant it; the delay need seldom be long, for limiting adhesions form quickly, and then the indication is to favor the rapid reduction of the size of the cavity. The iodoform acts favorably in several ways: it arrests the formation of ptomaines and pus; it drains well by capillary attraction; and it immobilizes the loops with which it is in contact. Its removal requires some force, and causes

some ρain; it should therefore be done gently, but resolutely and steadily.

Secondary sutures may be advantageously used to approximate the granulating surfaces and thus hasten cicatrization and perhaps diminish the chance of the formation of a hernia.

Second Group.—Operations done in a late stage of the affection for the simple evacuation of the abscess without exposure of the uninvolved peritoneum. The removal of the appendix is not contemplated, although exceptional circumstances may make it practicable. The list includes simple division of the skin at a place where the abscess is pointing, and the opening in the loin of those exceptional abscesses which have spread to and lie mainly in that region, concerning both of which I shall say nothing more; the opening of the abscess through an oblique incision running more or less parallel to the outer part of Poupart's ligament past the anterior superior spine of the ilium, either directly or after passing for some distance backward outside the peritoneum along the iliac fossa, and finally, opening through the rectcm.

Oblique Anterior Incision.—In the case of a large abscess of several days' duration, occupying the iliac fossa from Poupart's ligament upward, and adherent to the anterior abdominal wall without interposed intestines, the operation is very simple. An incision is made parallel to and about an inch above the outer half of Poupart's ligament and extending somewhat above and beyond the anterior superior spine of the ilium; it is carried through the skin, muscles, fascia and peritoneum, directly into the abscess; the pus is allowed to escape, a drainage tube and iodoform gauze are introduced, and the cavity is allowed gradually to close. The opportunity should be made use of to search for with the finger and remove any fæcal concretion or foreign body that may lie free in the cavity of the abscess or present in an opening in the wall of the appendix. If the appendix happens to be free from adhesions it may possibly be removed, but such an opportunity is entirely exceptional, and so long as the incision is restricted to the area shut off from the general cavity of the peritoneum by adhesions it will almost always be too small to permit an efficient search to be made for the appendix.

As the essential feature of this operation depends upon the direct continuity and union of the anterior wall of the abscess with that of the abdomen, the ·question of the existence of such union is capital, and unfortunately it must often remain unanswered until after the peritoneum has been actually divided. The temptation to seek evidence of the presence and proximity of the abscess by means of the aspirating needle after the peritoneum has been reached is great, and although the conditions may be more favorable for its safe use than when it must be plunged through the entire thickness of the abdominal wall, yet as it cannot tell of the presence of an unobliterated portion of the general peritoneal cavity in its path, and may even lead to a thrust of the knife and evacuation of the abscess through such a portion, it should be rarely resorted to. Incision is safer, for if it should open into the general cavity instead of into the abscess no harm is done, no great risk incurred, and advantage can be taken of the information thus gained to promote prompt adhesion between the walls of the abscess and abdomen and to complete the operation on the original lines after a day or two.

In like manner, if when the peritoneum is reached it is found to be freely movable upon the underlying abscess, their tardy union may be hastened by packing the wound with iodoform gauze, and the abscess may be subsequently opened with the knife or allowed to rupture spontaneously at the bottom of the incision.

The possibility, and, indeed, the probability in early cases, of not finding the abscess adherent in the line of the incision, led to a modification which I habitually employed until within the last two years, one which makes it possible with considerable certainty to reach and open even quite small abscesses without exposure of the general cavity. The modification consists in carrying the incision only through the transversalis fascia, and then proceeding a certain distance as for the extraperitoneal ligature of the external iliac artery; that is, the finger is passed backward and inward between the peritoneum and the iliac fascia, gently lifting and pressing against the former, and guided by the sensation of intra-peritoneal resistance. The abscess is thus approached from behind at a point where

in the great majority of cases its wall is composed only of softened peritoneum, and under the pressure of the finger this softened wall gives way and the pus escapes. A drainage tube and a packing of iodoform gauze provide for its continuous flow, and the abscess closes in the usual manner. I have opened in this way abscesses containing not more than an ounce of pus, and as early as the third or fourth day, and while in many ways it falls short of the ideal method of early operation through the peritoneal cavity with removal of the appendix, I would strongly recommend its use in preference to indefinite delay when the circumstances of the surgeon or patient are such that the risks incurred in a resort to the other method of operation would be unduly increased, or when it is refused by the patient.

Evacuation Through the Rectum.—The technique of this method, which is rarely indicated, is simple. After the presence of the abscess in the true pelvis behind the bladder has been recognized by digital exploration, and perhaps verified by the aspirating needle, the patient is anæsthetized, the sphincter slightly stretched, and a knife, guided upon the left forefinger, is thrust through the anterior wall of the rectum into the abscess, making a longitudinal cut about half an inch long. A drainage tube with only one or two lateral openings near its upper end is passed well into the abscess, and its lower end left projecting through the anus. In the only case in which I have had occasion to resort to this method the tube escaped during defecation on the fourth day; it was not replaced, and the patient went on to complete recovery without indication of further need of drainage. Probably a longer retention of the tube would be needed in most cases.

THE OPERATIVE TECHNIQUE OF APPENDICITIS.[1]

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I N THE class of cases in Dr. Stimson's first group the question is simply one of explorative laparotomy. We here enter upon a much broader field of study than the limits of this discussion will permit. As he truly observes, in the absence of all previous knowledge of the conditions present, with only the general symptoms of appendicitis and the possible addition thereto of right iliac pain, and the point tenderness of McBurney, the surgeon must be prepared to encounter almost all conceivable conditions, from a simply inflamed appendix all through the different grades of the disease, such as sloughing, ulceration, perforation, the formation of extensive or slight adhesions, and pus accumulations in unusual places. The only formal portion of the operation here consists in the planning of the incision in such a manner as to most easily reach the base of attachment of the appendix itself. But when once the peritoneal cavity has been reached, the rest of the procedure depends upon the experience, judgment and skill of the operator; no definite plan can be formulated for his guidance, but a few hints may be offered for his aid.

In this discussion, the ordinary precautions to be taken by the operator and his assistants need not of necessity be entered into. It is generally conceded, at the present day, that a grave responsibility rests upon the surgeon who increases the risks to which his patient is to be subjected in the operative

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[1] A discussion of the paper on the same subject by Dr. L. A. Stimson, presented at the New York State Medical Society, February, 1891.

procedure, by a failure to properly protect him from the noxious effects of putrefactive or pathogenic bacteria. There is a point, however, to which I desire to allude, as preliminary proper to the subject of laparotomy for appendicitis, and this relates to the cleansing of the integumentary surface of the abdominal wall before making the incision.

It is a well established fact that by far the great majority of the micro-organisms of which the surgeon of the present day stands in so much dread have their habitat in and about the patient himself. His underclothing, clothing and skin will furnish sufficient sources of infection to account for all the evils which only too often follow in the train of even the simplest or most trivial operation or other wound. I need not refer in detail to the various methods employed to prevent these, but will only call attention to a means which I have employed recently: I have reason to believe that I have observed less "stitch suppuration," which is the most common result of inefficient cleansing of the skin, since its employment than heretofore. The plan consists of simply giving the skin about the field of operation a coating or two of ordinary tincture of iodine a short time prior to making the incision. Whether the operation of incision and drainage on the one hand, or true laparotomy, on the other, is selected, the surgeon is, as a rule, obliged to reach the seat of the difficulty in as short a time as possible, and there is but very limited opportunity, in most instances, of giving the patient's skin that preliminary care represented by shaving, repeated scrubbings, bichloride bathings, soft soap poultices, etc. In this, as in other emergency cases, I have employed the tincture of idodine, after shaving and scrubbing, as an additional means of preventing infection from the skin.

When a skilled assistant is at hand, he is placed directly opposite the operator, the latter standing upon the patient's right. I am in the habit of relying upon this assistant almost exclusively to keep the coils of intestine out of the way, as I proceed in my search for the appendix. I consider this of the greatest importance, as it dispenses with the broad right-angled metal retractors, mentioned by Dr. Stimson. In place of flat sponges, compresses about ten inches square, made of

several layers of sterilized gauze, with their edges hemmed to prevent fraying, are used. These are kept at hand in abundance, placed in a hot sublimate solution. They are placed over the folds of intestine, as the latter come into view, and the assistant's fingers, by careful pressure upon the gauze compresses, keep the field of search clear. In the first steps of the operation, that of the lateral incision along the outer edge of the right rectus muscle, this assistant may sponge and tie vessels; but as soon as the cavity of the abdomen is open, his sole duty should be to take charge of the coils of intestine, keeping them out of the way by using his fingers as retractors, as above described. The sponges employed are made of sterilized gauze likewise. The large gauze compresses take the place entirely of all towels and napkins, thus simplifying very much the preparations for the operation.

When a skilled assistant is not at hand, the retractors are of service; the operator from time to time changes their position, always being careful that their corners and edges are well protected by the gauze compresses, in order to avoid injury to the intestinal surfaces; they must then be entrusted to whatever assistance is at hand.

It is not always easy to avoid the epigastric artery and vein, for if the incision is prolonged well downward, these are almost certain to be divided in the lower angle of the wound.

As soon as the cavity of the peritoneum is opened the operator may be confronted with a number of coils of intestines matted together, or he may find these free and movable upon each other. After carefully parting these, a gauze compress is placed over, and drawn upward over them and toward the median line by the fingers of the assistant. It has been my habit to have the outer edge of the wound well retracted at this stage, and search for evidences of pus toward the outer boundary of the abdominal and pelvic cavity; it is in this direction that the pus, if any is present, in the majority of cases makes its way. If this proves to be the case, all traces of it are carefully wiped away, and the adjacent folds of intestine carefully separated still further, the direction from which the pus flows serving as a guide to its source. Should no pus be present, search for the appendix is continued directly beneath

the line of the incision in the abdominal wall.   The fingers of the operator, as suggested by Dr. Stimson, serve best in this search; the adhesions being recent, are usually easily broken down.   A gush of pus from any direction is an indication to at once cease the manipulation until this has been wiped away, else this may be forced between the coils into parts from which it will be found impossible to subsequently remove it. Should the cæcum be reached without meeting any evidences of suppuration, the case is a favorable one; for when once the former is identified, the way is comparatively clear to a prompt removal of the appendix.   This is to be accomplished in the manner so clearly described by Dr. Stimson.

Care should be exercised in manipulating the appendix after its identification, lest, if it be not already ruptured, this accident occur before the ligature is applied, and the peritoneum be contaminated by fæcal matter exuding from the opening. A gauze sponge, placed beneath the point where the section is made, when this is possible, is a wise precaution, in order to prevent soiling of the parts by the escape of the contents of the appendix from its severed extremity.

I have never seared the stump with pure carbolic acid, simply contenting myself with thorough disinfection by means of the acid sublimate solution of La Place.

Should the base of attachment of a gangrenous appendix be involved, it is a wise precaution to place a few Lembert sutures in position on either side of the same, in order to fold the peritoneal coat of the intestine over the point of section, should such be deemed necessary after it has been ligatured. Otherwise simple ligature is to be preferred to the plan of folding in the edges of the stump and suturing them.

The best guide to the location of the appendix, when the colon has been reached without recognizing the former, is without doubt that mentioned by the last speaker. The longitudinal band upon the anterior aspect of the ascending colon, terminating as it does at the point of attachment of the appendix, should always be borne in mind.   At all events, in my judgment, search for the appendix should be persisted in until either it is found, or a well marked abscess cavity discovered.   In the latter case it is fair to infer that the appen-

dix, probably in an ulcerated or sloughing condition, is involved in the walls of the abscess cavity. This condition, it is scarcely necessary for me to suggest, would be a contra-indication to any further attempt at its removal; any interference with such a state of affairs would only unnecessarily imperil the patient's life without any compensating advantage.   Nature will take quite as good care of the appendix, accomplishing its obliteration almost as certainly as can the surgeon, and with much less risk to the patient.

I have never found it necessary to drain in any other than the direction of the wound itself, except in those instances in which the structures behind the peritoneum have been invaded. By isolating the seat of the abscess cavity, or the parts surrounding the points of section, in case of removal, with gauze compresses, and cleansing thoroughly the surroundings, the subsequent use of combined gauze and tube drainage will suffice.

I agree with Dr. Stimson in the matter of flushing the peritoneum, even though some pus may seem to have been diffused in the abdominal cavity. The use of hot water for this purpose has always seemed to me to be a delusion, and the additional advantage claimed for it in the shape of its stimulating effect I have failed to realize. It has been a matter of repeated observation to me that any stimulating effect which may have resulted from its use has been promptly followed by a very marked, and in some instances alarming depression.

In dressing the parts, I prefer to use zinc oxide gauze rather than iodoform, for the reason that the former may be sterilized by heat, is equally efficient as an antiseptic in this region, and will drain quite as readily. It should be packed around a glass drain in such a manner as to keep the folds of intestine from coming into direct contact with the parts that have been infected by pus, when this has been found. The ends of the gauze packing should be led by the nearest route to the abdominal opening. A strip of gauze should likewise be placed in the glass drain itself; the extremity of the latter should rest within the abscess cavity or at the site of the stump. In case no pus has been found and the surrounding parts have been left in a clean state, all drainage may be omitted.

I have a decided objection to permitting the gauze to re-main *in situ* longer than is absolutely necessary for the re-moval of septic material, or of fluids which are liable to under-go putrefactive changes.   This objection refers particularly to the tendency which its presence gives rise to in the shape of rapid formation of adventitious tissue and adhesions, which may subsequently become sources of danger to the patient.

The line of incision in Dr. Stimson's second group will de-pend somewhat upon the case at hand.   Where decided indu-ration is present, or a distinct tumor can be made out, it will be following good general technique to place the incision over the most prominent portion presented to us.   Willard Park-er's incision was placed parallel with Poupart's ligament, and at about the site usually selected for ligature of the external iliac artery.   This surgeon's operations were confined to sim-ple incision and drainage of abscesses in this region; for this reason the method usually attributed to him fulfilled all the indications; the addition of a vertical incision along the outer edge of the rectus muscle would be indicated in instances where the mass lies well upward, and is not easily reached by the plan just named.

In cases in which decided tumor is present, the dissection is carried directly to the mass.   As the latter is approached some evidences of inflammation will be found, as a rule, in the deeper structures.   An œdematous condition of these latter and a tendency to matting together of the parts is almost in-variably present, and in my experience, contrary to that of Dr. Stimson, pus is more often found than not, when these signs are present.   In fact, in studying my own cases, I have been struck by the fact that the presence of a well-defined tu-mor of inflammatory origin, without the presence of pus, in this region is a rare occurrence.   It is my habit, therefore, to seek at once for the surface of the growth, without attempting to identify both layers of the peritoneum, for the reason that these will be found adherent to each other; in other words, the tumor, with its superjacent peritoneum, will be found at-tached to the parietal peritoneum.   In these cases the opera-tion really consists of the opening of an abscess, and nothing more.   I have never been able to identify the appendix in

these cases, and if such identification were possible, it would serve no good purpose; the impossibility of effecting its removal without extensively damaging surrounding structures must be apparent at a glance.

The question of drainage in these cases will be decided on general principles. It may be necessary at times to drain through the loin, the lateral wall, or as has happened in one of my own cases in which the pus had found its way through the crural ring, in the thigh as well. The cases which demand drainage through the loin are those in which the post-peritoneal cellular tissue has become invaded; the addition of free incisions in the lumbar region will likewise here be found necessary in order to prevent general infection.

The length of time which is required for drainage will vary in different cases. In those instances in which the appendix has sloughed away close to the gut, and the latter opened thereby, fæcal matter will be found upon the first or second dressing. One need not necessarily be discouraged by this circumstance; I have succeeded, by daily irrigation and gauze packing, even under these unfavorable circumstances, in effecting a closure of the wound and opening into the intestine.

Should the external incision be an extensive one, there is no objection to the application of a few sutures, beginning at the angles and placing them in such a manner as to leave sufficient room for the drainage-tube and gauze packing to emerge. If fæcal matter is found at the start, this should be omitted and reliance placed upon gauze packing in the subsequent treatment; experience shows that, if the wound be funnel-shaped and largest without, the granulating process, as it goes on, by closing in the bottom of the cavity first, is far more likely to prevent the occurrence of a fæcal fistula as a sequel. If fæcal matter is found upon the dressing subsequently, any sutures that have been applied should at once be removed.

There is a class of cases, fortunately rare, in which the general symptoms of appendicitis are present, but in which failure to locate the lesion arises from the presence of an abnormality in the anatomical relations of the appendix itself. Such

a case recently came under my care. The entire absence of both local pain and tenderness, referable to the right iliac region, led me to delay operative interference, although the entire clinical picture, exclusive of these, suggested an appendicitis; rapid perforation and a prompt lethal exit followed. The diagnosis was established post-mortem, as well as the explanation of the absence of the classical symptoms of point pressure and iliac tenderness. The appendix was found lying to the left of the median line, and about an inch above the umbilicus, being fixed in this position by an exceedingly short meso-colon. In a similar case I should not hesitate to make the median abdominal incision as in an ordinary explorative laparotomy, the subsequent course of the operation being guided by the indications found to be present after reaching the abdominal cavity.

With the sole exception of the class of cases last alluded to, I know of no conditions, referable to the appendix vermiformis, for the relief of which any line of incision other than the lateral vertical of Sands or oblique of Willard Parker is at all applicable.

THE MÜTTER LECTURES ON SELECTED TOPICS IN SURGICAL PATHOLOGY.

SERIES OF 1890-1.[1]

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LECTURE II.

WOUND INFECTION AND SUPPURATION.

SYLLABUS.—*Predisposition to Infection, continued.*—Influence of manner of inoculation and arrangement of tissue; of irritating chemical substances. Miscellaneous influences. Variation in susceptibility. Concurrent growth of various bacterial species. Recognition of pyogenic cocci in the blood as an aid to diagnosis.

A Study of Pus.—What is pus? Different substances to which the name has been applied. Study of its gross and minute appearances, and circumstances under which it is produced. Virchow's views as to physiological and pathological irritations, and his four degrees of the inflammatory process. Old "humoral" theory. Cohnheim's teachings and their influence. Can we have pus without micro-organisms? Experiments with cadaverin. Study of the discharge from granulating wounds. Differences between acute and chronic abscesses, and the material they contain. Metastatic abscesses and *loci minoris resistentiae*. Minute anatomy of abscess.

The "pyogenic membrane" should be called "*pyophylactic*" membrane. Differentiation of so-called pus into true *pus, puruloid* and *archepyon*. Conclusions.

POINT OF INOCULATION AND ARRANGEMENT OF TISSUE.

BACILLI vary very much in their pathogenic effects, depending largely on the point where introduced, and the character of the tissue in which they are placed. Some

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organisms will not grow at large in the body, but only in certain tissues, while the character of the lesion may vary within wide limits, according to that of the tissue in which they thrive. The higher fungi act to best advantage within capillary blood vessels or large serous sacs. The bacillus of malignant œdema grows only in the cellular tissue, and the cocci of erysipelas thrive best in the lymphatic vessels and cellular tissue. Cheyne had some very suggestive results in experimenting with the *proteus vulgaris,* which is a common saprophytic organism. Introduced in quantity into subcutaneous tissue it provoked only abscesses, but the same amount introduced into the muscles would prove fatal, while a very small dose in the muscles was sufficient to produce abscess. He suggests that possibly some chemical substance in the muscle is split up and gives rise to poisonous compounds. Analogous results have been obtained with other bacteria. Fehleisen states that about one-twelfth of the quantity of staphylococci which is necessary to provoke peritonitis will cause suppuration in and around joints. He thinks also that pus varies in virulence according to its origin, different tissues probably producing different ptomaines. As affording the best illustration of the above statement Cheyne adduces the disease known as the *Black-leg* in England, *Rauschbrand* in Germany, or *Symptomatic anthrax* in France. It affects chiefly cattle and sheep, and is characterized by the rapid appearance of irregular nodules in the skin and muscular tissues, these being at first tense and very painful, but rapidly becoming painless and crepitating. It is accompanied by fever, usually high, but is generally fatal in from 36 to 40 hours. It is caused by anærobic bacilli, which are remarkable for the conditions by which they produce death. In order to affect the animal to this extent, they must be introduced either into the subcutaneous tissue or into the muscles. If injected into the veins or the bronchi they do not kill, but apparently die out after a little, leaving the animal protected against the disease. If after the virus has been injected into the veins a bruise is caused in some part of the body, the bacilli reach that spot and set up the disease. Inoculations made at the tip of the tail in cattle cause only a small amount of reaction. The nearer

the body the more marked the disturbance. All of which is to be explained partly by the dense tissues of the tail, and partly by the low temperature of the part, since if after inoculation the tail be wrapped in bad conductors of heat the reaction can be very much increased, and *vice versa.*

So far as the pyogenic organisms are concerned, most of them act in the cellular tissue, to which they gain access commonly after removal of the epithelium. The gonococcus appears to be the only bacterium which can penetrate uninjured epithelium, and even this only attacks certain mucous membranes. Bumm has shown that pure gonorrhœal pus may be injected into the subcutaneous cellular tissue without causing reaction, which proves that pus, apart from the microorganism contained in it, is not itself pyogenic. Moreover in such a case, if an incision into the part be made twenty-four hours later, the pus cells will be found in good condition, while the cocci have disappeared, which would seem to indicate a phagocytosis in this instance at least. As seen elsewhere, the pus of gonorrhœal buboes contains, not the gonococcus, but the ordinary pyogenic organisms, showing that such buboes are the result of mixed infection, the same being true of peri-urethral abscesses.

We have also evidence that the arrangement of tissue influences pyogenic action in the frequency with which pyæmia follows acute osteomyelitis. This is apparently due in large part to the great pressure to which pus is subjected in the interior of bone, and this high pressure is proven by the manner in which fat oozes out of bone when it is trephined; also by the occurrence of fat embolism in the lungs. There are numerous other illustrations, if one needed to introduce them, which go to show that bacteria appear to exercise certain selective affinities which are to be explained, we must suppose, by certain peculiarities in the tissues selected. The same is true of the higher fungi, like the pathogenic forms of mucor and aspergillus, the latter in the rabbit selecting the membranous labyrinth; which selection, in this instance, affords us an explanation of the rotary motion so characteristic of this disease in rabbits.

Irritating Chemical Substances.—These, when concentrated,

destroy the vitality of tissues, and when more dilute, set up at least the early stage of inflammation. The effect of such substances in producing a weak spot is no doubt the explanation of Kocher's result concerning acute osteomyelitis. He induced digestive disturbances by introducing large quantities of septic material into the intestinal canal. He then injured a bone by injecting ammonia or some other chemical substance into it, after which acute osteomyelitis occurred at the seat of injury, while the one disturbance without the other produced only temporary reaction. Experiments in the same direction, but slightly varied, give always the same result. The bearing of these investigations upon the development of blood poisoning in human beings can hardly be overestimated, and we shall have more to say about it when speaking of intestinal toxæmia. Cheyne argues from such facts as these that it is questionable whether, in granulating wounds which have become septic, it is well to wash them out with irritating antiseptics, as we so often do, unless these solutions are able to kill all the micro-organisms present in the wounds, and thus render them aseptic, fearing lest the chemicals might so far injure the granulation wall as to produce a weak spot in which pyogenic cocci might develop, and from which they might enter the circulation. Thus it has been found that in cases of tubercular abscesses of bones and joints disseminated tuberculosis occurs much more frequently where the sinuses have become septic, and more especially where these septic sinuses have been much irritated by inutile antiseptic injections. So he would avoid the use of carbolic acid, for instance, and simply wash away the discharge with some fluid which will not injure the granulation wall. Considering the known properties of peroxide of hydrogen, this may be an indication for its use in these cases. Of course, except in the case of wounds, the chemical substances, by aid of which bacteria gain a foothold, are themselves products of bacterial action. That many of these are wholly poisonous is now well known. Two of the ptomaines which have been most commonly experimented with are cadaverine and putrescine. These are products of putrefactive bacteria, rather than of the pyogenic. As we shall show later the pyoid material which has occasionally been

found after the introduction of cadaverine is not entitled to the name of pus, when it is, as it has been stated to be, sterile, since, according to the view adopted in these lectures, there is no fresh pus which is free from organisms. So far as the pyogenic cocci are concerned, Brieger states that he has been unable, at least until recently, to obtain from cultivations of these organisms, any true toxine. When the staphylococcus aureus or albus is cultivated on moist beef or veal, ammonia is given off, and the latter produces in addition tri-methylamine, the streptococci likewise producing both of these substances.

Ammonia is naturally irritating. The latter is closely allied to the ptomaines, and when present in considerable quantity is noxious. When these bacteria are cultivated in milk they rapidly set up pure lactic fermentation. This fermentation undoubtedly takes place in wounds, causing acidity of discharge and watery or very thin pus. That fever in suppurative disease may be explained by increased tisssue change as the result of bacterial growth without the necessary production of ptomaines, may be argued by analogy, as Baumgarten states in the case of the fever which occurs in trichinosis, where there is no idea of the action of ptomaines.

(Leber, a couple of years ago, claimed to have recovered from cultivations of staphylococci a crystalline substance which he called phlogosine, and which he said produced pus when injected into animals. *Fortschritt d. Med.*, 1888, No. 12, But since his publication we have heard little or nothing of this substance.)

Certain other influences also exert a decided effect in favoring suppuration, many of which figure prominently in the condition of the blood. Furuncle, carbuncle and other suppurative affections are known to occur frequently in cases of diabetes. Very recently Bujwid (*Centblt. f. Bakter.*, Vol. 4, p. 577) has studied this matter experimentally. He first found that staphylococci do not grow well in media containing 5% of grape sugar. He then ascertained that a given number of these cocci, insufficient to cause an abscess when injected alone, will do so when injected along with the fluid containing 25% of grape sugar. Also that a given quantity along with

excellent example of the part played by other factors in rela·
tion to infection. The itch of domestic animals is produced
by an acarus which may be almost seen with the naked eye,
and which lives in the superficial layers of the skin. Accord-
ing to the experiments of Delafond and Bourgingnon, this
insect when placed on the skin of well nourished healthy
animals does not penetrate nor propagate. Healthy sheep
cannot be artificially inoculated with itch, but if they are first
submitted to unhealthy surroundings as regards nourishment
and stabling, then the acarus can be very readily implanted,
and will flourish so long as the animals are thus kept. Just
so soon as their nutrition is improved and their stalls cleaned
and aired, then without treatment against the acarus the itch
disappears, and the animal beeomes clean. The same differ-
ences notably affect the silk-worm in France. The disease
known as *pebrine* attacks silk-worms, irrespective of their
state of health, while *flachérie* attacks worms only whose diges-
tive apparatus is weakened by disease or heredity.

*The recognition of pathogenic cocci in the blood, as an aid to
diagnosis.*—The statement has been already made, and is con-
firmed by so many observers, that the normal blood of healthy
animals does not tolerate the presence of pathogenic organ-
isms nor harbor them, that it scarcely needs repetition here.
Nevertheless, it is well-known that two propositions, each the
converse of the other, may be accepted as true; first, that, in a
condition of lowered vitality, they may be present in the
blood, and second, that when met with in the blood, they are
significant portents of impending evil. Although this has
been in a general way recognized for some time, Eiselsberg
has been perhaps the first to make practical application of the
fact and to introduce to the profession a new diagnostic aid of
some practical utility.

In the *Wiener klin. Woch.*, September 18, 1890, he has re-
ported four cases of supervention of high fever after injury or
operation, where the diagnosis of impending or present sep-
ticæmia was made by a bacteriological examination of the
blood, and confirmed by subsequent events. That such an
aid to diagnosis is not usually called for, will be generally
allowed, yet that it may have no small value is illustrated by

these cases, and if such identification were possible, it would serve no good purpose; the impossibility of effecting its removal without extensively damaging surrounding structures must be apparent at a glance.

The question of drainage in these cases will be decided on general principles. It may be necessary at times to drain through the loin, the lateral wall, or as has happened in one of my own cases in which the pus had found its way through the crural ring, in the thigh as well. The cases which demand drainage through the loin are those in which the post-peritoneal cellular tissue has become invaded; the addition of free incisions in the lumbar region will likewise here be found necessary in order to prevent general infection.

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12% of grape sugar did no harm; but that if in another animal the same quantity was injected and then a 12% solution of grape sugar was injected daily at the same spot, an abscess formed. Variations of these experiments, and their confirmation by Karlinski, show that the presence of grape sugar in the tissues so depresses their vitality that the pyogenic cocci can act in much smaller numbers and more vigorously than would otherwise be the case.

Dilution of the blood also interferes to some extent with the rapidity with which bacteria are killed in it. If water in quantity be injected along with non-pathogenic bacteria, they do not disappear from the blood so quickly as when injected without it. For other causes which may be included under this caption we must refer to Cheyne's excellent monograph.

There are extraordinary variations between different animals in regard to susceptibility, which are extremely significant. For instance, in the case of mouse septicæmia, a mouse will die as a result of the injection of a single bacillus, while a rabbit will tolerate the injection of 4cc. of jelly cultivation, containing millions of bacilli, with only slight local symptoms of swelling and redness. So too with so-called chicken cholera. A single organism is enough to determine the death of a rabbit but two or three hundred thousand are necessary to kill a Guinea pig; while ten thousand may produce an abscess, and less than that number have no perceptible effect. Cheyne has deduced from such results as these certain laws which he formulates as follows:

1. The pathogenic dose of a virus varies inversely with the predisposition of the animal to the disease in question.

2. In animals which are not very susceptible to a disease, the severity of the infection varies directly, within certain limits, with the amount of virus introduced.

Some as yet unexplained phenomena must be grouped under the heading of increased virulence,—a phenomenon well-known to all but quite inexplicable. For instance with regard to the bacilli of symptomatic anthrax, it has been found that the addition of a minute quantity of lactic acid to cultures increases the virulence of very attenuated virus in a short time, even one-fifth of one per cent will double their virulence in

twenty-four hours. So the pyogenic cocci when grown in milk produce lactic acid, although there is no evidence that their virulence is thereby increased. Ogston discovered that if he grew pyogenic cocci in eggs, their activities were notably augmented. On the other hand, lactic acid does not increase the activity of the pneumococcus which loses its virulence most quickly when grown in milk. Such facts may not yet have a practical bearing for us, yet they show by what slight and unexpected causes virulence may be altered. Experimenters are well aware of the changes produced by passing organisms through animals. For instance, Pasteur discovered that the bacilli of swine erysipelas are weakened by passing through pigeons, while the bacilli of rauschbrand are strengthened by passing through very young guinea pigs from one to three days old. The results of passing anthrax through animals, as well as of the unknown contagium vivum of hydrophobia, are well known. Also that in order to keep cultures of bacillus tuberculosis active they must be passed through animals every three or four generations.

Anthrax bacilli, in minutest doses, in mice, guinea pigs, etc., produce a rapid general, septic, fatal infection; in dogs and in older or larger animals very small doses have little or no effect, and larger ones cause carbuncle or œdema. In man they cause usually only malignant pustule, which has seldom any marked septic effect. The pnemonococcus when injected into the tissues of mice and rabbits produces a rapidly fatal septicæmia; only when injected into their lungs does it cause pneumonia.

So with the pyogenic cocci. Often after their injection in dogs no result follows. In man the item of individual susceptibility is one of great importance and at the same time of great variability. The immunity from septic complications which the wounded Turks displayed during the Turko-Russian war was remarked upon by German military surgeons. Undoubtedly. they were not lacking in opportunities for developing sepsis, yet they displayed such vital habits as made their bodies unfavorable soil for bacterial development.

Or to put this same idea in the words of Prof. Welch (in a private communication): "The pyogenic cocci are a curious

group of organisms which it is difficult to bring into line, as regards their pathogenic properties, with other infectious bacteria. Their effects seem to vary strikingly with their degree of virulence, with the number inoculated, with the place and manner of inoculation, and with those mysterious conditions which we call predisposition but which we little understand. And then, what a variety of pathological conditions they are capable of producing—from an innocent pustule to the most malignant pyæmia or ulcerative endocarditis."

It is of no small importance to consider the effect of the simultaneous growth of two or more species, by which pathogenic power may be at one time increased, at another diminished. In man, in all probability, pyogenic activity is thereby increased as is shown by the frequency of mixed infections. For instance, in wounds to which numerous species have had access a struggle probably results that terminates in favor of the pyogenic cocci, and this may be further complicated by the activity of saprophytic forms. Thus the foul smell of a wound, if present at all, usually subsides as time goes on, especially if drainage be good, showing that putrefactive bacteria gradually cease their activity. Nevertheless the ptomaines produced by the latter, when taken into the system, depress the vitality of the patient, and thus better fit these tissues to support the pyogenic cocci; while locally such products are injurious, as elsewhere described, owing to granulation tissues about the wound, and thus may open the way for systematic pyogenic infection. So Cheyne states that if a sinus leading to carious bone, whose wall is lined with membrane containing tubercle ('pyophylactic'), becomes infected by these cocci the result is a more rapid growth of the tubercle bacilli, by whose development general infection is made more probable, *i. e.*, local depression of vitality enables the tubercle bacilli to grow more luxuriantly. We shall have more to say on this subject when dealing with the subject of mixed infection.

The concurrent growth of bacteria is perhaps in no place better illustrated than in the pus coming from a wound which has produced tetanus. When speaking of this disease we shall call attention to the method by which the bacilli of tetanus may be isolated from other forms; but so far as their co-

existence is concerned we have a significant demonstration of the simultaneous growth of aerobic and non aerobic organisms; the former consuming the limited amount of oxygen present, and really producing the conditions necessary for the best growth of the bacillus of this dread disease.

Perhaps one finds no more conspicuous illustration of the various degrees of immunity enjoyed by different animals than can be met with in the susceptibility of different species to anthrax. A single bacillus introduced into a guinea pig certainly proves fatal, while rats often survive inoculation, apparently suffering little or not at all, this depending largely upon the age of the animal. The older the rat the fewer general symptoms does it manifest; the thicker the pus met with at the seat of the injection, the more rapidly do the anthrax bacilli perish.

There are other times when it is to the advantage of the patient to be the host of more than one species of pathogenic organism, thus taking advantage of certain antagonisms—some of which are well known. Ememerich has shown the value of the cocci of erysipelas, in rabbits, as protective against anthrax and even curative. His experiments have been confirmed by Mattei and by Pawlowsky, and the latter found no small degree of antagonism between anthrax bacilli on the one side and the micrococcus prodigiosus and the pneumococcus on the other. Whether the explanation be that the cocci by themselves prevent the growth of the bacilli, or that they irritate the phagocytes and increase their destructive power, or whether there is produced some chemical substance which is poisonous to the bacilli, is not known. It suggests, at all events, a possible treatment for anthrax in man by inoculation with erysipelas, and it at least raises the question whether, if tumors are really of parasitic origin, the well-known fact that they sometimes disappear after a local erysipelas, or after an erysipelas deliberately produced by inoculation, may not enjoy the same explanation. It will be seen further that the treatment for phthisis, by inhalation of non-pathogenic organisms, as already tried, may, after all, have a rational basis, although so far unsuccessful.

Duclaux, in his work on "Microbes and Disease" gives an

excellent example of the part played by other factors in rela-
tion to infection. The itch of domestic animals is produced
by an acarus which may be almost seen with the naked eye,
and which lives in the superficial layers of the skin. Accord-
ing to the experiments of Delafond and Bourgingnon, this
insect when placed on the skin of well nourished healthy
animals does not penetrate nor propagate. Healthy sheep
cannot be artificially inoculated with itch, but if they are first
submitted to unhealthy surroundings as regards nourishment
and stabling, then the acarus can be very readily implanted,
and will flourish so long as the animals are thus kept. Just
so soon as their nutrition is improved and their stalls cleaned
and aired, then without treatment against the acarus the itch
disappears, and the animal becomes clean. The same differ-
ences notably affect the silk-worm in France. The disease
known as *pebrine* attacks silk-worms, irrespective of their
state of health, while *flachérie* attacks worms only whose diges-
tive apparatus is weakened by disease or heredity.

*The recognition of pathogenic cocci in the blood, as an aid to
diagnosis.*—The statement has been already made, and is con-
firmed by so many observers, that the normal blood of healthy
animals does not tolerate the presence of pathogenic organ-
isms nor harbor them, that it scarcely needs repetition here.
Nevertheless, it is well-known that two propositions, each the
converse of the other, may be accepted as true; first, that, in a
condition of lowered vitality, they may be present in the
blood, and second, that when met with in the blood, they are
significant portents of impending evil. Although this has
been in a general way recognized for some time, Eiselsberg
has been perhaps the first to make practical application of the
fact and to introduce to the profession a new diagnostic aid of
some practical utility.

In the *Wiener klin. Woch.*, September 18, 1890, he has re-
ported four cases of supervention of high fever after injury or
operation, where the diagnosis of impending or present sep-
ticæmia was made by a bacteriological examination of the
blood, and confirmed by subsequent events. That such an
aid to diagnosis is not usually called for, will be generally
allowed, yet that it may have no small value is illustrated by

one of his cases, where for some days diagnosis wavered as
between an actual rheumatic affection, and osteomyelitis—in
which the discovery of pathogenic cocci in the blood and their
successful cultivation both cleared up the case, and furnished
an important indication for operation.   In three of these cases
staphylococci were found, in the other streptococci.   Aside
from these instances in which the examination had a diagnos-
tic value, he reports several other undoubtedly septic cases;—
for instance, three progressive phlegmons, one acute osteo-
myelitis and four cases of septic peritonitis, which were care-
fully examined, and in three of them staphylococci were found.
He alludes also to the rapidity with which these organisms
develop in the blood after death, and reports a most interest-
ing series of *post-mortem* observations in which cultures were
made from the blood of an individual dying of sepsis, at inter-
vals of 10 minutes, during the two hours immediately succeed-
ing death, from which it appeared that they developed at an
almost arithmetical ratio.

Having now discussed at some length the causes which
predispose to infection we are better prepared for an attack
upon the obscure, and yet tremendously important topic, of
suppuration or the formation of pus and a rehearsal of some of
its properties and varieties.

SUPPURATION AND PUS.

What is pus?   A few years ago this question was compara-
tively easily answered.   That it is now a query to which it is
extremely difficult to give an explicit answer, is simply an
evidence of progress in the study of pathology.   A former
and revered teacher used to express it tersely that "pus is
dead or dying blastema."   Even the term blastema is now
almost obsolete.   According to Robin, blastema means "the
substance resulting from the elaboration of nutritive material
furnished to the anatomical elements by the blood."   Foster's
dictionary gives as other definitions: "Undifferentiated em-
bryonic tissue; the material out of which a part is to be formed;"
and, "a free or parenchymatous plastic exudate."   These
definitions are sufficiently succinct to indicate that dead or

dying blastema must be good and valuable material going or gone to the bad. In a rough and off-hand way, therefore, this conception of the term pus may be considered sufficient as a working basis for a further study of the substance itself.

But, as generally used by the clinician, the term is applied alike to the contents of acute or cold abscesses, which have never known exposure to the air, to the discharge from mucous, as well as granulating surfaces, and to the fluid or semi-solid results of degeneration of various tissues. Are these various substances identical, and do they deserve the same name? This is a vexed subject in the domain of surgical pathology, to a discussion of which the balance of this lecture is in the main devoted.

Many and many a time have I seen my operation wounds heal by primary union, under an aseptic dressing. Of them I could say, as we usually do under such circumstances, they healed without suppuration. And yet, if the drainage tube—supposing one had been used—had been left *in situ* a few hours too long, there would be found about its opening, or in its lumen, a drop, perhaps a few drops, of creamy, semi-solid material, which we should ordinarily call pus. Is this material identical with the pus from an acute abscess? To this inquiry I have devoted no small time and study, both at the desk and in the laboratory, and such conclusions as I have reached shall appear further on.

There is a popular expression: "There are dogs and dogs." Must we not say also, "There is pus and pus."

This subject can only be approached by a careful study of the gross and minute appearances of pus, and the circumstances under which it is produced. A study by which these questions may be answered is inseparable from a study of inflammatory phenomena, with which I must then, for a little while again detain you.

Virchow has made this distinction between physiological and pathological irritation (Reiz), that in the former case the function of the cell, or the collection of cells (the organ), is simply increased; in the latter it is disturbed. The entire process by which an alteration or disturbance of nutrition is thus brought about by irritation he considers to be a progress-

ive process, but not necessarily an inflammation. It might re-
sult in hyperplasia (numerical cell-increase), inflammation, or
tumor formation. He classified irritations as mechanical,
chemical and physical, *i. e.*, thermic and electrical. Only such
irritations as lead to inflammation interest us here, and, as we
shall see, in considering pus formation that we shall have to
practically limit ourselves to a consideration of micro-organ-
isms as the sole causes of such irritation.

At that time (1870) Virchow distinguished four degrees of
the inflammatory process:

1. A form distinguished—aside from changes in the cells
themselves—by watery, serous, albuminous, or mucinous ex-
udate.

2. A form in which the exudate is fibrinous (croupous).

3. A form in which pus is produced.

4. A form characterized by hæmorrhagic exudate.

He considers these as progressive stages of one and the
same kind of irritation, belonging to either of the three classes
before named.

Applied to the study of repair of wounds, this doctrine
taught that mechanical irritation (which caused them)
alone was sufficient to explain the formation of pus, that it was
unnecessary to seek further for its cause, and that tumefaction
of the wound edges bears the same relation to failure to secure
primary union that suppuration does to healing by granulation.
This opinion seemed the more plausible since the wounds
whose borders presented least tumefaction were those which
healed most kindly *per primam.*

Attack upon this doctrine was speedy and determined.
Cohnheim had published in 1867 his studies of the diapedesis
of the leucocytes, and the importance of this publication, as
well as its accuracy, were almost universally recognized; while
the leading part heretofore played by the connective tissue
corpuscle, according to Virchow's views, had now, at least, to
be shared by the wandering leucocyte. This opinion has been
since strengthened, to the point of conviction, by the labors of
Cohnheim, Ziegler, and their scholars, so that now it is possi-
ble to find an explanation of such neoplasms as belong to the

category of inflammatory, regenerative, hyperplastic or callus, in the known properties of the leucocyte.

I say it is now possible, even probable, but hold that as yet we are not in position to go to extremes. Cohnheim's enthusiastic followers claim that Virchow has considered innumerable cells to be descendants of connective tissue corpuscles, which are in fact escaped leucocytes. Even granting this, there has been no sufficient evidence yet adduced to show that the connective tissue cells are necessarily or absolutely passive, and take no part in cell proliferation. Consequently, it seems as if, in this controversy, the middle ground is certainly the safer.

But the attacks upon Virchow's dicta were made not alone by the histologists, but by those who, like Klebs, contested them upon etiological ground. By 1872, in Germany, the Listerian system had been pretty well adopted, and there no longer remained a doubt but that wound suppuration was caused by contamination of instruments, fingers, dressings, etc., with bacteria. Other infectious inflammations, *e. g.*, endocarditis, erysipelas, were correctly ascribed to microbes, and, in 1878, appeared Koch's masterly work on "Wound Infection." Now, the importance of mechanical, chemical and physical irritations, as agents producing suppuration, was lost in the overwhelming magnitude of the freshly studied "specific reaction (suppuration) due to a specific virus." To be sure, Virchow retorted, in 1880, that we did not know the exact nature of this specific reaction, and that it must be either chemical or mechanical, which is undeniable, yet it is equally undeniable that bacteria did not figure as irritants, when he so fully discussed the causes and consequences of inflammation, and that he remains to-day rather a skeptic as to some of the new teachings in this respect.

The introduction of the antiseptic method has effected both a revolution and a revelation. It was till lately held that the bacteria of putrefaction were also at the same time the pyogenic. In 1881 Virchow and his scholars claimed that suppuration was not invariably produced by micro-organisms and by them alone, but that when it displayed a milder form, less progressive, it was brought about by purely mechanical

causes, fractures, wounds, etc.   But the researches of Ogston, Rosenbach, Passet, and numerous other close and diligent ob - servers, clearly demonstrated that suppuration has but one cause, that it is of parasitic origin, and that the pyogenic bac - teria are not to be confounded with the saprogenic or putre - factive.

Studies directed especially to the elucidation of these hotly - disputed questions resulted in unexpected advance.   Strass - burger, Fleming and others found that the nucleation which precedes cell proliferation afforded an interesting subject by itself, and karyokinesis is now a well recognized link in the chain of cell progression.   Not alone in the leucocytes is the karyokinetic process known; it has been studied in the con - nective tissue cells by Scheltema, Grawitz and Ribbert.   This fact lends additional argument in favor of a position midway between the extremes of Virchow and Cohnheim.   Whether the inflammatory irritant acts primarily upon the connective tissue elements, the capillary vessels, the muscular and the fatty tissues, whereby active hyperæmia and diapedesis of leu - cocytes are excited, or whether the reverse is true, will de - pend upon whether one sides with Virchow in the former case, or with Cohnheim and Weigert in the latter.

According to the views of the humoral pathologists, of whom Rokitansky was the father, pus corpuscles, which were seen in the exudate known to have left the vessels, were sup - posed to have originated from it, hence the definition of their day—"pus is dead blood." The ultimate cause of inflammation and suppuration was sought in the chemical condition of the blood; and the dyscrasiæ, or varieties of badness of the blood, were hence considered the causes of these phenomena. Although the old humoral pathology is now abandoned, it will be seen that it, nevertheless, took cognizance of certain truths, since such dyscrasiæ as diabetes, syphilis, and gout are well known to be predisposing causes of inflammation.

It was Virchow who decently interred this humoral doctrine, by showing that the formation of cells out of such exudates alone was impossible.   By establishing the dictum *omnis cel - lula e cellulo*, he founded the new cellular pathology, which was to medical science what Keppler's laws were to astronomy.

Proliferation of cells now accounts for all tissue changes, though, by itself, it fails to supply all the knowledge of causes for which we earnestly yearn.

The misinterpretion of certain cellular phenomena by the cellular pathologists has been, in great measure, atoned for by the discoveries of Cohnheim and his pupils, who repeated, in every possible way, the observations first made in 1848, by Waller and Wallace, and who not only established the fact of the diapedesis in the leucocytes, but showed the vast importance of this process in explaining inflammatory action. If they, in their enthusiasm, claimed for their observations a solution of the whole question, they simply showed themselves human, and so liable to err.

While we are not, even to-day, in position to do more than calmly survey the fields where the pathologists of the recent past have excitedly contended for the accuracy of their own notions, yet we must admit that somewhat of truth was contained in the humoral doctrine, and that Virchow and Cohnheim are both right and both wrong; wrong, however, mainly in each trying to explain everything upon his own discoveries and in refusing to see as much of the truth in the teachings of his opponent as in his own.

The question may perhaps be legitimately raised whether it is possible to have acute abscess formation without the action of micro-organisms. The answer to this question should cover two different phases of the subject. First, it remains to be proven that sterile pus, providing it be ever met with, is really entitled to be considered pus, since it can in no wise be infectious, and since ordinary pus owes its principle characteristics to the bacteria which it contains. In the second place it does not necessarily follow, because no bacteria are found in pus at the time of its evacuation, that they were not present in the beginning as active agents. Thus Rosenbach examined the pus from two suppurating hydatid cysts, and found nothing, but that this is not usually the case is proved by the observations of several others. The pus from suppurating buboes following chancroid has occasionally been found free from organisms, and yet they are so nearly ever present in such cases as to imply an indisputable origin to such pus. Cheyne speaking

of these cases states that such abscesses are doubtless caused by the virus of a chancroid, a virus which is in all probability of bacterial origin, but not yet recognized. If, however, we believe with Sturgis and some others that chancroid is not due to a specific organism but rather to a practical manifestation of the activity of known pathogenic forms, the explanation afforded by Cheyne will fall to the ground. In this connection he states that DeLuca has described a very similar coccus, which he considers the virus of soft chancre, and which he named *micrococcus ulceris*. This organism is a typical ærobe, and he explains the fact, if fact it be, that these buboes are not infected until two or three days after they have been opened, by the theory that it is not until after the access of air has been permitted for two or three days that this organism · attains its full activity. Could this be proven it would furnish a strong argument against early or free incision.

As will be seen throughout these lectures I am endeavoring to make an actual difference between pus such as comes from an acute abscess under ordinary circumstances, and which is due to and contains micro-organisms, and another material quite similar to it in macroscopic and even in microscopic appearance, which contains no bacteria, which has no infectious properties, which is not capable of causing sepsis, which is not met with clinically and almost never except as the result of laboratory experiments, which is a fibrinous exudate more or less rich in cells and due to the action of powerful chemical irritants, but which is not pus in the true sense of the term. Such material, which we will call, if you like, *pyoid* or *puruloid*, can be produced by the aseptic injection of sterile croton-oil, or turpentine, or cadaverin, or of certain other chemical poisons, and has been noted under these circumstances by so many experimenters that it is scarcely worth while to catalogue their names. It does not undergo the fate of true pus, and while it may remain for a time enclosed within the tissues, it undergoes no spontaneous evacuation as an abscess tends to extrude its contents. Where bacteria are at work they by their peptonizing action readily dissolve this material and prevent the coagulation of fresh exudates and the absorption of the old. On the other hand where bacteria are not at work

the tissues possess the power of dissolving and removing dead
material, while such portion as cannot be removed is encapsu-
lated and removed from further consideration.

(If any exception is to be made to the above statement it is
with reference to cadaverin, which is stated by Grawitz and
Scheuerlen to be not merely an irritant, but to prevent coagu-
lation; but inasmuch as this is a ptomaine, we are, by its injec-
tion, reproducing, to a large extent, the conditions which would
be furnished by bacteria if present.)

Grawitz has experimented carefully with *cadaverin*, which
seems to combine the useful properties of an antiseptic and
disinfectant with the undesirable powers of producing necrosis
and inflammation. Two and a half per cent solutions destroy
the pyogenic staphylococci after one hour's contact, and
smaller proportions added to nutrient gelatine hinder or pre-
vent their growth. Subcutaneous injections produce, accord-
ing to their strength, necrosis, pseudo-suppuration or inflam-
matory œdema. In this pseudo-pus there are no pyogenic
organisms. When five or ten per cent cadaverin solutions are
mixed with pus cocci and then injected, the latter either die,
or, as the injected fluid is reduced in strength by the tissue
juices, they manifest their vicious propensities and cause acute
phlegmons and abscesses. (*Virchow's Archiv.*, cx, p. 1).

Scheuerlen showed how solutions of cadaverin and putres-
cin, and various putrid substances, without aid from micro-
organisms, could evoke a pseudo-suppuration; which neverthe-
less had nothing progressive or infectious about it. (*Fortschrit.
d. Med.*, 1887, No. 23, p. 762). Fehleisen, however, showed
that all these ptomaines possessed the property of delaying or
preventing coagulation of the blood, and then repeated
Weigert's statement that the suppuration is in large measure
an affair of limitation of this process.

There is yet another material analogous to pus · which de-
serves brief consideration here. I allude to the puruloid exu-
date upon the surface of granulating wounds. This material
is physiologically different from that which an acute abscess
contains inasmuch as it represents a useful product, at least the
remains of a useful product, since for the repair of all tissues
which heal by granulation there is necessary a certain amount

of formative material, and this material can only come from
pre-existing tissues, and must be supplied, at least in the main,
from the blood. A quantity of leucocytes is constantly fur-
nished to the granulating surface of which only a certain
amount or proportion can be utilized. So many as are utilized
undergo metaplastic changes, and become organized into
tissue of a higher grade. Such of them as fail to be so utilized
become the pyoid discharge from the healthy ulcer. No-
where in connection with wounds is this fluid free from con-
tact with the air, and consequently it is very likely to become
infected on reaching the surface. If so infected it scarcely
differs in any respect from true pus. If not so infected it will,
nevertheless, show nearly the same constituents under the
microscope, lacking only bacteria and necrotic shreds of
tissue or debris. No granulating surface ever can cicatrize
without the presence of a certain amount of this fluid.
Unquestionably, however, irritating dressings or exposure
to air, cause excess of discharge and infiltration of its cells.

In view of what has been said it will be seen that the true
test as to the aseptic course of healing after a given operation
or wound, is not so much as to whether any such puruloid
material has been formed, but as to whether pathogenic bac-
teria have or have not been excluded. The typical aseptic
primary healing of a fresh wound comprehends perhaps the
absence of all puruloid discharge. Where, however, a drain-
age tube or drainage material has been introduced there will
occasionally be found a few drops of gelatinous, creamy look-
ing material upon the dressing, or obstructing the calibre of
the tube, and this might easily give rise to the statement that
such a wound had not healed, as enthusiasts claim it should
under such dressings, without formation of a drop of pus.
Some time ago, before I was aware of the investigations of
others, I set myself the task of studying this matter in my own
cases. It was at a time when I was using rubber drainage
tubes much more than I do now in fresh aseptic cases. If
upon the first dressing I met with any such material, cover
glass preparations were made from it at once, and tubes of
gelatine or agar were at the same time carefully inoculated
with it. Subsequent observation of such cases has convinced

me that while this material is not necessarily always sterile, it is quite usual to find it so, and that many a wound goes through a typical aseptic course, from which, nevertheless, a small quantity of such fibrinous exudate may come, this exudate being due apparently to the irritation caused by a foreign body, mainly the drainage-tube or even the suture material.

Quite corroborative of my own studies are the investigations of Bossowski who undertook the examination of fifty wounds which had been protected by antiseptic (iodoform) dressings. Each fresh wound was irrigated during the operation and at its conclusion with a 3% carbolic solution, and the iodoform gauze to be applied next the wound was soaked in 5% carbolic solution. Of the wounds thus treated only one fifth (20%) remained free of organisms. About one-sixth (17%) showed themselves contaminated by non-pathogenic organisms, of which the *staphylococcus gilvus* was most important on account of its resemblance to the staphylococcus pyogenes aureus and albus. About one-half the wounds revealed the presence of the staphylococcus albus, although the majority of them healed *per primam*. The number of these cocci was very small. The balance of these contaminated wounds (about a third) showed trifling or limited suppuration. The other wounds not including the above showed that staphylococcus pyogenes aureus, or streptococcus pyogenes were present, and they all were suppurating.

He is inclined to consider that the so-called aseptic-wound fever of Volkmann and Genzmer is due to the circulation in the blood of some of these bacteria or their products. He reminds us that V. Eiselsberg found pyogenic bacteria in the blood of feverish injured or operated patients; (*vide* above).

Bossowski also investigated the material contained in the drainage-tubes removed five to seven days after operation. He cut off a piece with sterilized scissors and dropped it into the culture-tube. He found that the pale reddish, somewhat translucent, thick clot which the tube sometimes contains, as well as the clear, serous, reddish fluid which often escapes, were free from bacteria. The softened, dark red or dirty yellow secretions and detritus usually contained organisms. Of course

the plainly sero-purulent discharge always contained them. The researches of Staheli have also given about the same results.

After it was definitely understood that all surgical suppurations were of a parasitic origin, an effort was made to establish for the bacteria which caused them a property *sui generis*, as if they were neither chemical nor mechanical irritants, but possessed some hitherto unknown power. Such a theory prompted the investigations at once set on foot, during 1885-6, and conducted with most painstaking diligence by Hüter, Rosenbach, Orthmann, Lutton, and numerous others, to be referred to again, by which it was demonstrated that pure or sterile chemicals alone could never produce suppuration. Scheuerlen, Klemperer, Strauss, and others, have repeated these demonstrations, and have made conviction certain, that without bacteria or their products, suppuration never occurs. Some difficulty and confusion have arisen from the fact that it was found, in prosecuting these studies, that certain bacteria were pyogenic in the tissues of one animal, and not in those of another. Thus Grawitz and Dieckerhoff described a bacillus which thus varied in its effects according to the animal used.

In 1886, Grawitz and de Bary showed that very weak dilutions of pure cultures of the pyogenic bacteria (1 to 100, etc.), were resorbed without provoking suppuration. The daily use of ordinary solutions for hypodermic use is simply a homely illustration of this fact. They further showed that such active fluids as turpentine and strong nitrate of silver solution, which are of themselves actively parasiticide, when used upon certain animals in certain amounts, produced a fluid resembling pus. This fluid, however, contained no bacteria, lacked all the septic or infectious properties of true pus, and was produced under such conditions as never obtain, save in the laboratory of the experimenter, and at his pleasure only, at the expense of extreme precaution.

This is an appropriate place at which to stop, en passant, and ask whether it is fair to call such a fluid pus. Its like is not met with clinically, and the pus which we daily meet with, and which causes us so much trouble, is the pus which

we particularly study, and which is particularly deserving of the name.

Moreover, aside from Grawitz' and Scheurlen's results after the injection of Brieger's cadaverin, it is, furthermore, quite probable that other ptomaines besides cadaverin, all of which are of bacterial origin, may be found to have a similar effect, though several, at least, have failed so far to evince it. Let it be well emphasized just here, however, that even these few substances which thus have been shown capable of producing this puruloid material, do so only under the most favorable conditions of time, quantity, and species of animal used for experiment. Weak ammoniacal and cadaverin injections are resorbed; those of greater strength are followed by watery or albuminous infiltrations, or, sometimes, by exquisite fibrinous exudates; used still stronger, they cause hæmorrhage and this pseudo-suppuration; and, finally, when used in full strength, necrosis and gangrene are the consequences. It seems to me, upon both theoretical aud experimental grounds, that this puruloid fluid, to which I have above alluded, may be properly considered the product of the death of the cells, resulting from the inflammation set up as a result of the injection of the irritant, and the liquefaction of previously solid tissues, and that it is entitled to be considered pus only in the sense that it is dead blastema; whereas we all know that the pus with which surgeons meet and contend is something more than dead or even dying blastema; that it contains, at least when active and septic or infectious, living and lively organisms, whose activity and properties are most pernicious. Here is beautifully demonstrated the accuracy of one of Virchow's observations, which were, in the main, brilliant and comprehensive, that tissue reactions or changes are not characterized by wide distinctions; that pus-production is not to be considered, by itself, as a distinct process, but only as a stage in the various possible inflammatory changes in connective ' tissue. Adopting this view, we see that the differences between the formation of this puruloid fluid and of pus, consist, in a pathological sense, in the penetration into the tissues of destructive germs, and, in a clinical sense, in the overwhelming pathogenic importance which the tissues and the purulent material

now acquire by virtue of their presence and poisonous capa-
bilities.

In clinical evidence of this feature, let me adduce the differ-
ence between an acute and a cold abscess.   In the former the
bacteria are still alive and actively producing poisonous ma-
terial, in proof of which we have fever, sepsis, local destruc-
tion, even death.   In the latter case, nature has thrown a san-
itary cordon around the infected area in the shape of a thick
investing membrane, the so-called but mis-named *pyogenic
membrane*, inside of which the pyogenic bacteria have finally
perished from starvation.   These cold abscesses persist for
months, even years, and may slowly disappear by well-known
changes, while the patient presents few, perhaps no signs of
fever, sepsis, nor of any trouble.   In other words, so long as
bacteria can live and migrate, the fluid in which they disport
themselves is pus, true pus; the fluid of an old cold abscess is,
according to this view, no longer pus.   It was pus once; it is
now *puruloid* in a second sense.

I have tried often to make cultures of pyogenic bacteria
from this material and failed, for reasons just stated; so have
many other observers failed, and our position in this matter is
indisputably the correct one.

Garré has made a careful study of a number of cold abscesses, and with the ex-
ception of a few arising in lymph glands from which he could cultivate the staphy-
lococcus pyogenes aureus, the only bacterial elements he could find were tubercle
bacilli.   These were with difficulty recognized by culture tests, but always by the re-
sult of inoculation.   He contends that the view that pyogenic cocci had been pres-
ent, but had been destroyed, can scarcely be entertained, since the pus out of these
very abscesses could be used as a culture medium for the same pyogenic cocci, which
could not be the case had their kind perished in it.

Garré concludes that so-called tuberculous pus is in reality not pus at all, but
represents softened and separated necrotic caseous remains of previous tubercle ele-
ments.   It contains mainly cell fragments and albuminated or fatty detritus, in con
tradistinction to the pus of acute abscesses which contains well formed pus cells.

The relative infrequency of tubercle bacilli in such pus, and the difficulty of rec-
ognizing them even by cultivation, or in any way save by inoculation, leads him to
the hypothesis that this material owes its infectiousness rather to the presence of
tubercle *spores* than to the adult bacilli, the former finding only in living tissues the
condition requisite for their growth.

Garré's views as to the nature of tubercular puruloid are corroborated by Baum-
garten, as well as by Terillon.   (Prog. Med., 1887, No. 2.)   (Deutsche Med. Woch.,
1886, 34, p. 581.)

Tricomi, after investigations concerning the ordinary periarticular abscesses of tubercular joint disease, claims that so long as they remain closed they never contain pyogenic cocci, but only tubercle bacilli, if any. (Giorn. Internaz. dell Scienze Mediche, 1886, 6, p. 628.)

The conspicuous difference between the teaching of 1871 and that of to-day obtains in this, that the degree of inflammatory disturbance necessary for the production of pus is not produced by mechanical nor thermal lesions alone, nor by even chemical irritants, except under most peculiar conditions. All suppurations met with in practice are due to bacterial agency, but mainly when, through this agency, nourished within the tissues or planted upon absorbent wound surfaces, they propagate themselves and give forth their peculiar chemical products, *i. e.*, ptomaines. Still, even then, without some predisposing lesion or condition in animals and men, in tissues capable of resorption, the commonly known pyogenic cocci are innocuous.

To this fortunate fact it is due that not every wound suppurates which is not immediately provided with an antiseptic dressing.

While there is, virtually, no pus without bacteria, the reverse is not necessarily true; for we may have even pyogenic cocci present in relatively very small numbers without formation of pus. A careful study of these cases shows them to be those in which suppuration is imminent but not yet absolutely existant. For instance, there may be present a mild degree of swelling, with an albuminous exudate, all of which may be resorbed without pus formation. Whether we are to look with favor, or not, upon Metschnikoff's explanation of the disappearance of the relatively few bacteria present in such cases, is a matter which I hesitate to discuss, though, for my own part, I certainly think it offers a most attractive and reasonable explanation. Virchow's vivid picture of the "battle of the cells" surely loses nothing from Metschnikoff's treatment of the same subject, and phagocytosis is not yet disproved.

Virchow introduced the term "metastatic," and taught us what metastatic abscesses are, and the embolic process by which they are formed. This term also loses nothing of its significance in the light of recent enlargements of our knowl-

edge.   The emboli which cause them are themselves infected, or even individual germs may be transported *via* the blood current as most minute emboli, and the only uncertain or unappreciated feature of this part of the subject is the determination of why minute and metastatic abscesses appear in one place and not in another.   This may be, in some cases, the result of pure accident.   In general, it compels us to fall back upon the explanation of a *locus minoris resistentiæ*.   This may be some mechanical lesion, perhaps one too minute for our vision, or some fracture or previous inflammatory focus. Points of least resistance certainly do exist, though what constitutes them such may be beyond our ken.   No one can long study minute pathology without being convinced that there may occur a certain vulnerability of tissue, so to speak, for which we can offer no suitable explanation. The communication of contagion from one person to another is common evidence of this fact.   Tissues, then, which suppurate are vulnerable in this respect: they succumb from not having the power to resist infection—that is, the invasion of their bacterial enemies, and the pus is the evidence of the conquest of vegetable cells over animal cells.

The matter is a difficult one to treat of. We have forms and forms of pus-formation.   As Grawitz has shown, we have to deal with pus under at least four apparently different circumstances:

1. Cases of typical pyæmia.

2. Abscesses at points of least resistance.

3. Apparently spontaneous suppurations; *e. g.*, acute osteomyelitis.

4. Abscesses at points where there has been previously an inflammation.

He and Rinne have pointed out that the localization of pyogenic cocci is an affair of local determination, of interference with absorption, of chemical poisoning (through the circulation), of local ischæmia, etc.; in other words that by existing local irritations, by beginning inflammatory disturbances, or by regenerative cell-proliferations, in spite of previously held opinions, the metastatic grouping of cocci is absolutely prevented.

Rinne divides suppurations into two groups:

1. Those determined by bacteria of peculiar activity, whose attack upon the organism is vigorous; *e. g.*, tuberculosis, actinomycosis, epidemic cerebro-spinal meningitis, are caused by such organisms as seem to have a peculiar virulence, aside from any pyogenic properties.

2. Those determined by the members of the now well-known group of pyogenic cocci, particularly including staphylococci and streptococci.

We are confronted in this study by a most significant fact, which is very difficult of explanation. We have experimental proof that pyogenic cocci may be introduced into the tissues in no inconsiderable number—the same thing occurring every day in many accidental ways—that they may even be found circulating in the blood, without calling forth either suppuration or notable inflammation. According to the researches of Wyssokowitsch they do not escape by the kidneys. What, then, does become of them? It would appear, Grawitz says, that (*a*) they are dissolved, and disappear in the blood and other fluids; or that (*b*) there is an active conflict between them and the cells, a struggle for existence, which Virchow, as stated, has already called "the battle of the cells." The best known defender of the first view is Baumgarten, while Metschnikoff's name is most prominently associated with the second. Here again, there is really much to be said on each side, and there seems to be no reason why each may not be right. According to Grawitz the cocci usually die in pus after six to ten days, that is at a time when cell activity in the pus has ceased. Beyond a certain point increase of cocci is impossible in pus since the fluid becomes a too concentrated albuminoid material for them, just as syrups are too strong sugary solutions for the growth of fermentative and other organisms. On blood-clot they do not grow, though they will on blood-serum. Active penetration of cocci into white corpuscles is out of the question; therefore, when they are found in the interior of leucocytes, the latter must be regarded as the active agents. Certainly cocci are found inside the pus-cells, for anyone may see them there, and pus-cells, if we know anything about pus, were many of them originally leucocytes.

Certainly, too, one cannot say which he has to deal with, when isolated, a pus-cell or a leucocyte, unless he finds it containing one or more cocci imbedded in it.

If, then, in this battle of the cells, when once infection has taken place, the parasites are victorious, whether from overwhelming numbers, or from finding their enemies weakened from disease, then the infection of the surrounding tissues extends, and metastatic abscesses may finally or speedily result in the patient's death. On the other hand, if the tissue elements can successfully resist, then the battlefield is surrounded by a wall of young cell elements, which are very rapidly proliferated, and we have only a local abscess, in whose walls certainly takes place some of the phagocytosis which Metschnikoff has so successfully described. The course of that particular suppurative process is henceforth determined, not so much by production of some ptomaine, as by the reaction of the cell elements most concerned. So soon as the bacteria die or are killed, in case the pus has not been evacuated, the pus-cells undergo fatty metamorphosis, gradually disappear by absorption, or perhaps caseate in part; for an indefinite time there remains a concealed scar to mark the site of the old battleground, and finally all local and general damage is repaired.

The minute mechanism of abscess formation is of no small interest. Where infection occurs through the blood, the organisms are deposited in the smaller capillaries in the form of minute emboli, as is seen in pyæmia, and their first effect is the change in the tissues so well described by Weigert under the name of coagulation-necrosis. Sections through the periphery of such abscesses show that in immediate proximity to the central purulent mass there is a zone of tissue which takes no stain, and which presents a homogeneous translucent appearance, evidently resulting from the action of concentrated products of the micro-organisms, or from their own action, and constituting the coagulation-necrosis. If examined at the proper time a second zone appears outside this, which is composed of a dense mass of leucocytes, apparently collecting where chemical substances are more dilute and interfere less with cell life. The first zone becomes infiltrated on the one

hand with cocci from the infected center, and on the other hand with cells from the outer rim, and, with the original tissue, rapidly disappears, probably largely owing to the result of the peptonizing action of the cocci. Meanwhile, for the same reason doubtless, the effused fluid does not coagulate, and thus we have a central collection of fluid containing leucocytes and cocci, that is, an abscess. When cocci spread into tissue after injection, or from infection of the skin, they usually at first follow the course of the lymph canals, and we find a central area of yellowish appearance containing leucocytes and cocci, surrounded by an inflamed area infiltrated with the same. The cocci, according to the density of the tissue spread in masses or singly, forming, in loose tissue, small groups or chains of a few individuals, the cellular elements swelling up and forming a homogeneous mass (coagulation-necrosis) ultimately undergoing liquefaction as before. Outside of this a zone of leucocytes is formed for the purpose of withstanding the onset and checking the progress of the micro-organisms. After a few days they usually get the upper hand, and the acute process is at an end. In the case of proteus vulgaris, which causes abscesses in rabbits, and of the bacillus of chicken cholera, which causes abscesses in guinea pigs, there is a mass of necrotic tissue in the interior of the abscess which is left undissolved on account of their feeble peptonizing power. The only difference, practically, between abscess and purulent infiltration is the circumscribed or indefinite boundary of the area involved. The principal difference between abscess and carbuncle is that in the latter there is no such perfect solution of dead tissues and cells. The coagulation-necrosis appears to involve such a mass of tissue at once that its solution and escape as pus is impossible. The bacillus of chicken cholera causes abscess in the guinea pig, and the proteus vulgaris causes them in rabbits, and in each case there is left a mass of necrotic tissue in the interior of the abscess whose solution has failed, perhaps on account of the feeble peptonizing power possessed by these organisms.

In man the chain of events is nearly the same as in the lower animals, save that they occur perhaps more quickly. The description above given refers more especially to abscess caused

by staphylococci. The streptococci seem to have a slightly different method of action, and it may be that the differences between the two species are due, in some respect, to their varying peptonizing power.

Herein, too, we see the difference between recent and old abscesses, in respect to the so-called "pyogenic" membrane. The protective cell elements thrown out about an infected spot, as alluded to above, are a matter of hours, or, at most, of a few days' existence. No time is afforded for organization, nor is it desired. They are meant to serve only as a temporary barrier. Consequently, in an acute abscess we must not expect to find any such membrane, and, if it is folly to look for it, how much more so to describe it, as some have attempted to do. Only in the subacute abscess, or for some weeks pent-up collection of pus, can we find anything approaching it. But it is in the cold abscess, the long-existing one, *par excellence*, that we find a membrane or lining which can be peeled or stripped off; though it is a sad misnomer to call it a pyogenic membrane, since it is anything but this. It is the result of the organization and condensation of this zone of protective cell elements, which were thrown out when the infection and the encroachment were new, which was supposedly intended to be temporary, but has persisted as long as that encroachment from which it was originally intended to protect, and which has grown old and hardened in this service. It is no more pyogenic in the strict sense of the term than it is chromogenic, and its name should be dropped for a better term. If we must have a descriptive name for this membrane, and it is well that we should, I would like to suggest that we call it *pyophy-lactic*, as indicating clearly its function if not its appearance.

Pus proper comes to our notice in four ways:

1. In circumscribed subcutaneous collections of new formations—acute abscess.

2. From the surfaces of shut sacs and cavities—empyæmas.

3. On exposed tissue surfaces and granulating wounds—pyorrheas.

4. In the shape of purulent infiltration of subcutaneous tissues, more or less deeply occurring.

Pus proper, then, is a mixture of originally good cellular

materials infected and gone to the bad, suspended in fluid more or less albuminous, and containing at times adventitious substances, like biliary or hæmic coloring matter, tissue shreds, etc.

When pus-cells have undergone fatty changes, when vital activity of all cells, parasitic or otherwise, has subsided, and when more or less of the fluid portion has been absorbed, leaving more concentrated, semi-fluid or solid residue—and when this has perhaps undergone caseous degeneration, then this material is not pus in the sense in which I am using the term, whatever it may have been originally. So long as it has the general appearance of pus, I would suggest for it the name *pyoid* or *puruloid*. When it is caseated, or is so thick that it does not flow, I would suggest that we then call it *archepyon*, that is to say, "originally pus."

I introduce these new names to you with considerable hesitation and with becoming modesty, yet I am convinced that if we had names for the different materials, or the different conditions of the same material, it would conduce to clearer notions concerning the substances themselves.

Certain conclusions based upon the above study may be formulated here, as follows:

1. Inflammation is, in effect, a disturbance of cell nutrition, along with cell proliferation, causing a recurrence to the embryological condition of certain of the cells of the tissue most involved.

2. This embryonal condition means a reversion to the form of those medullary or indifferent corpuscles, from which in the beginning of its normal development the tissue was built up.

3. Congestion, and even stasis, though they precede inflammation, do not necessarily cause it. They may subside before cell nutrition has had time to suffer. They may simply cause temporary cell activity.

4. Medullary, indifferent, or embryonic cells arise not only from the recognized cells of the tissue, *i. e.*, its active protoplasmic elements; it is probable that the intercellular or basis substance, which was originally produced from embryonic tissue, may again give rise to them.

5. When such new formed embryonic cells advance again

to the condition of basis substance, much of the inflammatory new formation has subsided. When with this is coupled restoration to the circulation of exuded fluids and such red and white blood corpuscles as are capable of return, and when all other newly formed cells are liquefied and absorbed, then the process of *resolution* is complete.

6. When both inflammatory and new embryonic cells establish a reticular intra-connection, then we have a true hyperplasia.

7. When into this collection of cells, parasitic vegetable cells (bacteria) are intruded, no matter how, blood-vessels break asunder, basis substance is dissolved, the individual animal cells are attacked, and these are now suspended in an albuminous fluid and represent pus corpuscles, and we have a collection of pus.

8. Pus-cells are no longer fit for any useful purpose, but constitute a source of offence. Henceforth they are treated as foreign bodies, of which the tissues endeavor to rid themselves at once. Nature extrudes them in the direction of least resistance, and hence we have the well-known phenomenon of the "pointing" of the abscess.

9. So far as we can learn, bacteria, and bacteria alone, can determine, in the human body, such a series of changes as lead to the formation of pus, *i. e.*, pus within the meaning to which I have endeavored to confine it. Whatever results may follow experimental introductions of a few chemicals into the tissues of some of the lower animals, such experiments find no parallel in our clinical experiences. Moreover, as stated above, the product of such experiments is not pus, but puruloid; it lacks the essential pathogenic and noxious elements of pus,—the micro-organisms which confer upon it its infective and toxic properties.

10. We are then prepared to make the brief and explicit statement that, *clinically* at least, we have no suppuration except such as is produced by bacteria; in other words, that pus is a product of parasitic origin.

REVIEWS OF BOOKS

A Contributibution to the Surgery of the Spinal Cord. By William Thorburn, B.S., B.Sc., M.D. (London). With Diagrams, Illustrations, and Tables. Royal 8vo., 230 pages. London: Charles Griffin & Co., Exeter Street, Strand. St. Louis, Mo : J. H. Chambers & Co., 914 Locust Street.

The field of operative surgery has been so much extended during the past decade that an author can no longer include in a single volume discussions of all the various branches of the subject. The tendency to specialize is becoming more and more marked, and in this volume the writer has considered the spinal cord alone. As is stated in the introduction the book does not claim to be an exhaustive monograph upon the subject considered, but the author has endeavored to collect and classify many reports which have appeared in journals, and in current medical literature from time to time of cases in which the spinal cord has been injured. To these he has added his own clinical observations and deductions in a most interesting and instructive series of similar cases which came under his immediate care during a number of years, as Surgical Registrar to the Manchester Royal Infirmary. He calls attention to the vagueness and indefiniteness, which, until very recent years, has characterized most of the published descriptions of the symptoms of spinal injuries, so that they were almost valueless for the purpose of throwing light upon the more obscure questions of spinal pathology and physiology, or even of permitting an accurate diagnosis of the cases themselves. Such accidents, however, properly observed and studied, would constitute a most valuable accumulation of "experiments" for illuminating questions of spinal physiology and pathology, and every exact contribution to this fund is important. The

growing tendency upon the part of surgeons to invade the spinal cord, calls also for special studies to increase the accuracy of those diagnostic methods upon the skillful use of which depends the extension of surgical achievement in this field. In this spirit the author has approached his work, and gives us as the result this volume,

The body of the work is made up of a series of clinical histories of patients who have suffered from various lesions of the cord. These are carefully arranged. The first set discussed are those in which there have been injuries to the cervical region of the cord. Twenty-one such cases came under the author's notice, and are considered at some length. This group is interesting from its relation to the brachial plexus, and, as a result of careful study, many valuable facts concerning the distribution of these nerves to the intrinsic muscles of the upper extremities were discovered. The table of classification of the distribution of nerves arising from the cervical nerve roots as given by Ferrier and Yeo from physiological experiments upon monkeys chiefly; by Gowers, giving the results of clinical observations; and by Herringham from a purely anatomical point of view, are each considered. The author, however, does not accept any of these as final, but gives a table, embodying the results of his own investigations, where "the extent of the paralysis has been deduced partly from the obvious loss of voluntary controll over the mnscles, partly from the positions assumed by the limbs, and partly from the electric reaction." The exact site of the lesion was generally subsequently confirmed by post mortem examination. The table given differs in several particulars from the three first mentioned, and the histories of the cases, with the comments made upon each, show unusually accurate observations, and anatomical knowledge.

Next in order is the chapter devoted to injuries to the dorsal region of the cord, with a history of seven cases. To these is added a table of twenty-seven cases, as arranged by Gurlt, where the lesion was subsequently determined. As a result of his study of these cases, the author calls especial attention to the fact that, in the majority of cases where there is a bony lesion, the cord alone is injured, leaving the nerve-roots intact, so that the upper limit of the anæsthesia observed

is considerably below the lesion of the cord—a fact of especial value when the surgical procedure of trephining of the spine is indicated.

Four cases in which the cauda equina was the seat of injury are next discussed. After a careful tabular comparison of the symptoms observed in these cases, Dr. Thorburn supplements this rather meager list by the observations of other surgeons of note upon the same class of injuries.

Chapter V. is devoted to injuries of the lumbo-sacral region of the spinal cord. Here, as in the cases involving the brachial plexus, the author deviates somewhat from the tables of distribution of the nerves in the lumbar and the sacral plexuses as given by other authors, and gtves a table derived from his own observations. To substantiate his claims he describes quite fully sixteen cases, where this region was involved in the injury, and besides his own comments upon the cases, there are numerous cross references used which add to the value of his deductions.

Using these forty-eight cases as a text, Dr. Thorburn goes on to consider the indications for operative treatment in affections of the spinal cord. Such of the author's own cases as were operated upon are first considered, and then follows a most valuable table, twelve pages in length, giving a resume of fifty-six operable cases. The name of the operator and the date of the operation are given with each case, and also, in order, the reference to the publication from which the information was derived, the symptoms before the operation, the nature of the operation, the subsequent course of the disease, the result, and the region of post-mortem appearances in the fatal cases. The statistics go to show:

1. That in the vast majority of cases, the results of fractures and of dislocations are incurable where an operation was not performed.

2. That, owing to modern antiseptic precautions, the operations upon the cord are not necessarily fatal, nor so dangerous as to be unjustifiable.

3. When the operation has been successfully pdrformed, the spine is not sufficiently weakened to prevent the performance of its normal functions.

The author says, in summing up: "It would appear then that the operation of trephining the spine for traumatic lesions, as compared with the condition which it is intended to relieve, does not present any very great dangers, and appears unlikely to increase the gravity of the prognosis, but that as *a priori* argument, and the results of published cases show that it is unlikely to be of service, it should be abandoned except in cases of injury to the cauda equina, and that in the latter, on the other hand, it will probably prove to be an eminently justifiable and serviceable procedure."

Caries of the vertebræ and other pressure lesions are touched upon, and then follows a chapter devoted to the ophthalmoscopic changes in injuries to the spinal cord, and in traumatic neuroses.

The concluding chapter upon traumatic hysteria, especially in relation to railway accidents, is the most interesting, and in many ways the most practical one in the book. There is a careful distinction made between neurasthenia and hysteria, and traumatic hysteria is defined as, "a functional disturbance of the nervous system, resulting from an injury, due probably to a change localized in some portion of the cerebral cortex, and manifested by correspondingly well-defined and localized symptoms. Or we may say that it has no known organic basis, that it is not reflex in origin, and that it is neither shock nor neurasthenia." The term thus adopted is a comparatively new one, but it commends itself as being preferable to the rather vague terms "railway spine," "railway brain" and other expressions used to represent these same conditions. The etiology and symptomatology are discussed carefully, and are illustrated by a number of cases. Especial attention is directed to the influence which the hope of compensation has upon the course of the disease, a fact which the author emphasizes by showing how rarely are such neuroses met with in railway operatives who pass through the same experiences, but who rarely, if ever, develop traumatic hysteria. The usual treatment of rest, seclusion, and tonics is advocated.

Such illustrations as are introduced into the work, though chiefly diagrammatic, are in most cases taken from photographs, and are valuable adjuncts to the text.

In the introduction the writer says, "It must be generally admitted that, until very recent years, the published descriptions of the symptoms of spinal injuries have, except in the hands of a few observers, been so vague and indefinite, as to be almost valueless for the purpose of throwing light upon the more obscure questions of spinal pathology and physiology, or even of permitting an accurate diagnosis of the cases themselves " Bearing this in mind Dr. Thorburn has written a book in which the unimportant details are omitted; in which the careful, complete, and accurate observations that the author makes, and his logical conclusions and deductions therefrom, are expressed clearly and concisely; and which is a valuable addition to surgical literature.

H. P. DE FOREST.

ANILIN FARBESTOFFE ALS ANTISEPTICA UND IHRE ANWENDUNG IN DER PRAXIS. VON PROF. DR. J. STILLING, Erste Mittheilung.

ANILINE-DYES AS ANTISEPTICS AND THEIR USE IN SURGICAL PRACTICE. Strassburg, Karl J. Trubner, 1890; New York, G. E. Stechert; St. Louis, J. H. Chambers & Co.

This paper is divided into three parts and is preceded by an introduction.

The first part treats of bacteriological investigations as to the antiseptic value of the violet aniline stains, which were done with the assistance of Dr. J Wortmann. It was observed that the addition of methyl-violet to a soil, in the concentration of 1 in 30,000, prevented the development of putrefactive micro-organisms. The development of staphylococcus pyogenes aureus on agar soils was prevented by a proportion of 1-64,000. A number of other experiments were also done.

The second part of the *brochure* contains the results of experiments on animals, 20 cubic centimetres (about $5^1/_2$ fluid drachms) of a 1 1000 solution of methyl-violet. free from arsenic, injected subcutaneously in rabbits and Guinea-pigs produces no deleterious effect; but half of this amount kills the animals when injected into the peritoneal

cavity, not by septic or any other form of inflammation but probably by coloring and paralysing important nerve-centres. The blood is not colored or poisoned by the stains. The animals may be fed with large quantities of the dye without detriment.

The third part of the monograph contains the therapeutic observations of the author. In all varieties of inflammatory affections of the eye, (keratitis, iritis serosa, choroiditis and sympathetic ophthalmia) he found much benefit from the use of the aniline and pronounces its effects far ahead of other antiseptics.

In surgery he healed a number of inflammatory conditions, such as an inflammation of the matrix of a toe-nail, commencing abscesses of the hands, burns and ulcers in an incredibly short time without operative interference.

In conclusion he opens a vista to the curing of all suppurative and ulcerative processes by these substances, and even sketches out a method of technique for use in operations, placing the instruments in weak solutions of the stain, and saturating the silk ligatures and dressings with stronger ones.   W. W. VAN ARSDALE.

ON SPONGES AND THEIR USE IN SURGERY.

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FEW of the common needs of a surgical operation are in more general and constant requisition than sponges. They are above all the most efficient means we can employ for the particular ends required. It is, however, purely in their physical effects, that their efficiency rests. Nothing absorbs so well, nothing so conveniently conveys fluid to a part; and yet, with these advantages, their use may be fraught with the greatest possible danger. A sterile or aseptic sponge is safe in its use as well as efficient; but a sponge not sterile may contain within it seeds of disease. It is with this question of the sterility of sponges, that the following remarks are concerned.

A sponge, to all external appearance, may look perfectly clean and smell quite sweet, and yet, when employed at an operation, contain within it that which will give rise to a fatal issue. It was owing to such an unfortunate result in one case, and the nearness of a similar issue in another, that I was led to look into this matter regarding the sterility of sponges.

In discussing this subject, it is very necessary to give, first of all, some short account of the nature of sponges; their mode of acquirement and method of preparation; for not a little of their ultimate efficiency depends on certain features connected with one or other of these points.

Nature of sponges.—The sponges, as we see them in ordinary use, consist of a skeleton or framework of horny, elastic fibres, which interlace in every direction. This framework is composed of a substance called keratode, and is itself in the natural state, when living, coated with a soft gelatinous material,

called sarcode. The skeleton is strengthened by calcareous or more generally by siliceous spicules. When examined under the microscope, the fibres composing the framework are seen to be transparent, uniform in their calibre and structure, although some are narrower than others. The fibres join freely in all directions, producing spaces, which may be of any shape or size.

If a piece of sponge be finely teazed out; placed under a cover glass on an ordinary microscope slide and a drop of water deposited just at the edge of the specimen, it will be seen, by using a moderately high power of the microscope, that the fibres of the sponge gradually swell as the water creeps along the tissue, thus showing the actual affinity, which the latter has for fluids. The keratode very readily takes up and fixes aniline dyes and by thus staining the fibres, a very pretty and distinct appearance is given to the sponge framework.

Sponges cannot be used in fluids where the temperature exceeds about 90° F. They then begin rapidly to shrink, and, if allowed to remain any time, no matter how short, in boiling water they soon acquire a dark brownish color. A sponge, which has thus been shrunken, maintains its diminished size, and although still absorbent, has acquired a peculiar elastic character. A small piece of its tissue, thus boiled, is seen microscopically to have undergone considerable changes. There is no longer any regularity or translucency in the fibrous meshwork of the tissue. The fibres have become much deeper in color and almost opaque. They are split and fractured, and present irregular excrescences The whole shows also great contraction from the diminution in size and shape of the interfibrous spaces. A sponge, which has been boiled so as thus to have its intimate structure destroyed, becomes on drying perfectly hard, like a piece of wood.

The acquirement and preparation of sponges.—The sponges, which are in general use, are obtained either from the Mediterranean, from the West Indies or from the coast of Florida, The Mediterranean, or as they are better known, the Turkey sponges, are the finest and most expensive. These sponges, when fished up, are subject to the following process:

On removing the sponges from the water, the gelatinous matter, which is of a brownish yellow color, and of a decidedly fishy odor, begins to run freely from it. It is necessary, however; to hasten this process in order to prevent the evil effects of putrefaction. For this purpose the sponge gatherers dig round, shallow holes in the sand along the shore which are filled with water. In these the living sponges are placed and then trampled upon until the canals are entirely free of the gelatinous protoplasm, sarcode, or "milk of the sponge," as the fishermen call it, and nothing remains but the keratose skeleton, known as the sponge of commerce, together with a certain quantity of sand, taken in at the pores, during the process, and which is got rid of afterwards. After this, they are packed in bales and exported.

On reaching the wholesale dealers, they are subjected to baths of dilute muriatic acid and permanganate of potash, and when subsequently dried are ready for the market.

The sponges which perhaps are more largely and frequently used in hospital surgical work, from the fact of their much greater cheapness as compared with the Turkey sponges, are from the West Indies and the coast of Florida. From the account given in the *Pharmaceutical Journal*, of the acquirement and preparation of sponges obtained off the coast of Florida, it appears that the process is somewhat different to that adopted in the case of the Turkey sponges. As soon as the sponges are fished up and brought on board, they are carefully spread over the deck of the vessel, in their natural upright position, so as to allow the slimy matter, called "gurry" by the spongers to run off easily. During the first stage of decomposition, they smell strongly of ammonia and are extremely noxious. Later the ammonia scent disappears, leaving a stronger one, very similar to that of decaying sea-weed. Sponges, if kept on deck, will generally die and lose the greater part of their gelatinous matter in one or two days, therefore, when thrown into the crawls (an enclosure of stakes 8 or 10 feet square, situated in water 2 to 4 feet deep) the chief part of the curing to be done is the removal of the outside skin or covering. In cold weather they live much longer than in warm. In summer, and when they are dead at the time

they are placed in the crawl, the week's soaking that they undergo softens all the remaining slime and skin they contain, and a little squeezing and beating with a short, heavy stick, called a "bruiser" suffices to clean them completely. They are squeezed as dry as possible and thrown into a dingy to be strung in the form of bunches on rope yarns, six feet long. This is to allow them to bleach and dry. They are afterward stowed in the hold. When dry they are in condition to sell to the wholesale merchants.

In order to give the sponges a bright yellow color, which adds to their value; they are what is called "limed." This process consists in dipping them into a weak solution of lime and sea-water, after which they are hung up out of doors to dry. If an excess of lime is used, the tissues are injured and the sponges become rotten and worthless; and if also they are not completely dried they soon become ruined.

These, then, are some of the facts connected with the life history of sponges and their process of preparation for commerce. I propose now to point out, wherein I venture to think lurk some of the dangers that may render them often unfit and unsafe for surgical purposes.

Part of the process of preparation consists in the removal of the gelatinous material or sarcode from the sponges. This is effected in the case of the Florida sponge by squeezing and beating, and in that of the Turkey sponge by trampling. According to the efficiency with which the process is carried out, will the sponge be more or less comple ely deprived of its gelatinous sarcode. Where incompletely removed the center or densest part of the sponge would be the most likely part for its retention. Before packing, the sponges are dried, so that what remains of the dead—possibly putrified—Sarcode is retained in the center of the sponge, inert and harmless until by moisture, heat and other favorable conditions, the microbes therein embedded are enabled to reach new fields and produce such results as they may be capable of. On arrival in this country, however, sponges are submitted to further processes of cleansing, which may have some slight antiseptising effect. Thus, as already stated they are subjected, to baths of dilute hydrochloric acid and permanganate of potash. This, while

possibly effecting some degree of cleansing, does not, as I shall shortly show, render a sponge, without further treatment, fit for surgical purposes.

Another source from which sponges suffer in the process of preparation, is the "limeing" which they undergo, in order to give them a bright straw yellow color. Here, as above indicated, any carelessness in the process may cause considerable injury to the sponge structure. The only way, however, in which this injury to the tissue may effect the value of a sponge surgically, is, that when limed, or incompletely dried after the limeing, they may last but a short time.

I dare say it is not unfamiliar to many, the peculiar, soft, almost slimy like condition into which a sponge often gets, after being in use for some time. What precisely this is due to, it is hardly possible to say, but fairly suggestive causes, I think, may be found in what has immediately preceded. Mr. Rose of the Sauchiehall street branch of the Glasgow Apothecaries' Company, to whom I am much indebted for information of various kinds, connected with the present subject, tells me that this slimy-like condition of sponges is something new within recent years. He attributes it to a different process of preparation, to that employed many years ago. At that time the sponges were not so rapidly prepared. They were buried for a considerable time in the sand before being further treated. Such a prolonged process would render it much more probable that all the Sarcode would be removed from the fibrous meshwork of the sponge. One possible explanation of this peculiar change in the consistency of the sponge may be due, then, to imperfect removal of the sarcode. The only feature against this conjecture, and that a not unimportant one, is that time and constant use should further improve the sponge by the sarcode gradually escaping. The sponge, however, never does again recover its original condition. It would seem, therefore, that another explanation must be sought for. A not unreasonable one is to be found in the process of limeing. As already shown, this, if not carefully carried out, will completely ruin the sponge. It may therefore be, that the condition under discussion, owes its origin to some defect in this part of the process. That it does not occur

in all sponges renders some such explanation the more prob-
able.

I must now leave this introductory discussion on sponges,
and turn to that which was the real incentive to my taking
up the subject.

I had performed the operation of ovariotomy. The cystoma
had an unusually broad pedicle. Some difficulty arose in con-
nection with bleeding points, and it was necessary to check
hæmorrhage by pressure. This was efficiently effected by a
sponge. Forty-eight hours afterwards the sponge was removed
and found to be septic. Fortunately the patient was but
slightly affected and made a good recovery. In the second
case above alluded to, where a fatal issue resulted, a sponge
was left in the abdomen, through the nurse having divided one
at the time of the operation, and forgetting that thereby an
additional sponge had been added to the original number.
The patient died and a sponge was found in the abdomen, the
center of a fœtid abscess. With my own experience in the
first case and the coming before my notice of this latter, where
on both occasions I had reason to know that the operations
were performed with all proper antiseptic precautions, I felt
that the mischief which had arisen in both cases must have
been connected in some way with an inefficient mode of
rendering the sponges sterile. The more so, from the fact, that
in both cases the sponges were prepared in precisely the same
way.

Actuated by this feeling, I determined to have some sponges
prepared for me as those had been prepared for the operations,
and subject them to some experimental tests.

The sponges were taken new—as supplied from the hospital
store—thoroughly rinsed in hot water and then placed in a
solution of carbolic acid (1 in 40) for the night prior to the
operation. On the morning of the operation they were placed
in a fresh solution of the same.

Two sponges so prepared—a Cuban wool (which is an open
textured sponge) and a Cuban fine (which is a close or dense
textured sponge) were squeezed by the hand as free as possi-
ble of the carbolic solution, and then each divided by a
sterilized pair of scissors. From the center of one sponge so

divided, small pieces were removed by another pair of sterilized scissors and inserted into tubes of Koch's beef-peptone jelly, previously liquified. Pieces also were taken from the other sponge in the same way and inserted into similar tubes of jelly. The tubes—two of each—were placed in the incubator and left at a temperature of 37° C. for forty-eight hours. On examination of the tubes at the expiry of this time, the two containing pieces from the dense or close textured sponge were muddy in appearance, while those containing pieces from the open textured one, were quite clear. A microscopical examination of the muddy jellies showed them to be loaded with microbes.

Thus experimentally, one had been able to show that the sponges—although prepared with great care and every intention that they should be clean and f.t for use, were not rendered aseptic. The 12 to 18 hours immersion in a 1 to 40 solution of carbolic had not asepticised the close textured sponges, but apparently had done so the open textured ones.

The same experiment was repeated a second time, except that I prepared the sponges myself. One of each kind of sponge was taken and thoroughly washed in hot water. (This washing brings out usually a considerable quantity of fine sand, which renders the water milky in appearance). The two sponges were placed in a 1 to 40 carbolic solution, where they remained for twenty-four hours. Each was divided and pieces removed from the center and placed in jelly tubes, in the same manner as above described. The tubes were placed in the incubator for forty-eight hours. Development of microbes took place in the tubes containing the pieces from the dense textured sponge; none in those containing pieces from the open textured one.

Still a third time the experiment was repeated, only on this occasion with pieces of the dense textured sponge alone, and just as above, extensive development of microbes took place in the tube, *i. e.*, rapidly in those placed in the incubator, more slowly in those left in the room at the ordinary temperature.

These experiments seemed to prove, with little room for doubt, the inefficiency of solutions of carbolic acid of a strength of 1 to 40, to sterilize the central part of close tex-

tured sponges, but its power to do so, in the case of loose tex-
tured ones. This failure on the part of carbolic acid led me
to try the sterilizing power of solutions of bichloride of mer-
cury. I did not test stronger solutions of carbolic acid, be-
cause, among other reasons, sponges used direct from such
solutions would be inconvenient, if not sometimes harmful,
and at all times expensive from the quantity of solutions re-
quired. Since my object, therefore, was a practical one, I
made use of solutions that could be used in large quantities,
and for this purpose I chose a 1 in 2000 solution of mercuric
perchloride, such as is in common and constant use in surgical
practice.

The Cuban fine or dense textured sponges were alone used.
The sponges were thoroughly washed and frequently rinsed.
They were then placed for twenty-four hours in the mercury
solution, at the end of which time pieces were inserted from
the center of the sponges into tubes of jelly. Two tubes were
placed in the incubator and two in the room. No development
of microbes occurred at any time subsequently. Thus it ap-
peared that the mercury solutions had succeeded, where the
carbolic had failed.

To test more severely the relative sterilizing power of the
two solutions already used and to eliminate a possible objec-
tion against the last experiment—that no control had been
made and that therefore the sponges from the first may have
been aseptic—the following experiment was performed.

A Cuban fine sponge was placed immediately against or
over the orifice of a discharging sinus situated in the thigh of
a patient suffering from necrosis of the femur. When removed
from the wound on the following day, it contained a quantity
of excessively fœtid pus. The sponge was placed in a glass
receptacle and kept until the following day, and when then
exposed it smelt about as bad as it well could. The sponge
was taken from the receptacle, rinsed and squeezed several
times in hot water. After this washing it still maintained an
offensive smell, which was more marked in the center of the
sponge after it had been divided.

Each half was now put into a separate receptacle, the one
containing a solution of carbolic acid of a strength 1 in 40, the

other a solution of bichloride of mercury of a strength 1 in 2000. They were left in this solution for eighteen hours when tube cultivations were made in the way already described. Two tubes of each were placed in the incubator.

On the following day the two tubes containing the carbolized fragments had each a dense opaque scum upon their surfaces while the two tubes containing mercurialized fragments were perfectly clear.

Why carbolic acid of a strength 1 in 40 should fail to have any sterilizing power appears at first sight, for many reasons, rather puzzling. Thus, I have frequently made solutions of this strength with ordinary unboiled water—such as it flows from the tap in my laboratory—and while cultivations made from the pure water itself always revealed the presence of microbes, those made from the same water into which carbolic acid to the above strength had been added, no such existence of microbes was ever detected. Microbes, therefore, floating freely in water were killed, but existing in the heart of a sponge, they were unaffected. The possibility occurred to me that the sponge tissue might have some special affinity for carbolic acid and so, in a way, filter it from the solution, which reached the deeper parts. This led me to try a simple experiment in support or otherwise of this possibility. A piece of sponge was tightly squeezed into a glass tube, and the tube—open at both ends—held perpendicularly. A very weak solution of carbolic acid—1 in 100—was then poured into the tube at the upper orifice, allowed to percolate through the compressed sponge and collected in a small glass flask, placed beneath the lower orifice. The fluid so filtered, and an equal quantity of the same, which had not been used, were then treated with equal quantities of perchloride of iron, with the result that, so far as the eye could detect, no difference in the colorization produced existed in the appearance of the two flasks; in other words, no carbolic acid appeared to have been taken from the solution in its passage through the sponge.

The real explanation of this apparent contradiction of the action of carbolic acid upon the microbes in the tap water and those in the sponges is to be found, I believe, in the difference of the species of microbes acted upon.

I know, from the many examinations I have made of the water in my laboratory, that it is almost entirely free from putrefactive microbes, while many of those present in sponges are of this class.   So that it would appear that the difference of the action of carbolic acid is to be explained, on the one hand by its germicidal effect upon non-putrefactive microbes, and on other hand by its inertness upon saprophitic and pathogenic microbes.   This very fact of the inefficient sterilizing power of 1 to 40 solution of carbolic acid on saprophitic and pathogenic microbes has been attested by many.   Thus, it has been shown by cultivation experiments that instruments dipped in solutions of this strength are not properly sterilized. Little wonder, then, if the complex structure of sponges containing within their dense and intricate fibrous meshwork dried masses of sarcode should fail to be properly sterilized by this same solution.

The practical lessons, then, which these various experiments seem to teach are that sponges, which are most open in their meshwork are least likely to be septic from causes connected with their preparation ; that these same sponges are easiest to sterilize ; and that a solution of bichloride of mercury, of a strength of 1 in 2,000, is the best sterilizing medium.   It follows from the above, that large sponges and thick, dense sponges are those most likely to be septic, and are those which will require some care in order to efficiently sterilize them.

Taking these various factors into consideration, the best sponges for surgical use are the small cup Turkey sponges. Their texture is close but their shape prevents them from being anywhere so thick that they would fall under the objection above mentioned.   One advantage, also, of no little importance is, that in these sponges, there are not the same loose tags of tissue projecting from the surface, which so frequently exist on the surface of the more open textured kinds.   They are about double the price of the Florida sponges, but their greater expense is quite compensated for by their convenience and safety.

When our sponges have been properly sterilized, how should we preserve them during the time they are not in use ? Should we keep them dry in air-tight rubber bags, which pro-

tect them from any external contamination? Or should we keep them constantly immersed in some antiseptic solution? To ascertain whether sponges were in any way deleteriously affected by prolonged immersion in the commonly used antiseptic fluids, I took two Florida sponges (Cuban fine) placed one in a vessel containing 1 in 20 carbolic solution and the other in a vessel containing 1 in 500 mercury solution; both it will be seen very strong solutions of the antiseptics. The vessels were each covered by a cap of gutta percha tissue and left exposed to light in the laboratory. At the end of nine months I examined them. Both had darkened very slightly in color; the carbolic one more than the mercury one, but neither had suffered in consistency, nor could a microscopical examination detect any thing amiss in their minute structure. To all appearance they were in as complete a condition as when first inserted. The belief, which to some extent exists, that mercury solutions blacken sponges is, I believe, a fallacious one. It is not uncommon, for the sake of distinguishing the solution from other like colorless ones, to put a little aniline dye into it. Not unfrequently it is a little methyline blue. Now, the sponge texture has a great affinity for the dye, and will, as I have tried, completely decolorize a fluid so tainted. The sponge thus becomes darkened in appearance, due, therefore, not to the mercury, but to the dye.

Sponges, however, do in time darken, not from their being actually dirty, but from pigmentation or staining of the skeleton of the sponge from various causes. To remove this darkened appearance, they are subjected to different processes of bleaching. I will only mention two—permangano oxalic acid and the hyposulphite.

The former consists in first placing the sponge for a few minutes into a solution of permanganate of potash, 1 ounce of the salt to 4 pints of water, and then for the same time into a solution of oxalic acid made by adding 1 ounce of the acid to 4 pints of water. The result of this process is to make the sponge of a very pale, almost white color.

In the hyposulphite process the sponge is first steeped in a weak hydrochloric acid solution—1 in 10—then immersed in a bath composed of hyposulphite of soda, 1 part, hydrochloric

acid, 2 parts, and water, 12 parts. This solution is then pressed out and the sponge well washed in cold water. It is finally placed in a bath composed of carbonate of potash, half an ounce. I have tried the former process and found it effectual but the latter I have not tested. I should be disposed to say that when a sponge has reached that condition, when a bleaching process appears necessary, it has well passed the time when it should be discarded for all surgical purposes.

I cannot conclude this discussion without referring to a consideration which must, I venture to think, very materially influence us in our use of sponges for surgical purposes.

Much has been discovered and is being discovered regarding the products of microbes, and the injurious effects, which these so called ptomaines or toxic albuminoses are capable of producing. How far, it may be asked, does the sterilizing of a sponge affect these? All we know is, that we can kill the microbes present, but we have no knowledge in what way, if in any way, we affect their products. Thus, then, it seems quite possible that a septic sponge might be rendered quite aseptic, as we understand it, and yet be the means of conveying toxic agents to a part. In consideration of this possibility, therefore, the right practice would appear to be, to discard forthwith all sponges which have been used for any distinctly septic cases.

OPERATION FOR COMPLETE PROLAPSE OF THE RECTUM ATER THE METHOD RECOMMENDED BY DR. JOHN B. ROBERTS, OF PHILADELPHIA.

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I N THE ANNALS OF SURGERY for April, 1890, (No. 4, vol, xi) Dr. Roberts described an operation which he had performed for complete prolapse of the rectum, and which had yielded a most satisfactory result. The details of the operation, which the author described as "probably new," and the report of the case operated upon, arrested my attention partly from its apparent feasibility, but chiefly for the reason that I had at the time in my hospital wards a very bad case of complete prolapse, which seemed to me to be utterly irremediable by any method of operating then known. It is therefore with the object of putting this case on record in support of Dr. Roberts' operation that I submit this communication. As the operation is fully described in the article referred to, and also in Dr. Roberts' "Manual of Modern Surgery," recently published, I shall content myself with stating that it consists in the "removal of V-shaped portions of the sphincter and of the entire posterior wall of the rectum." The following is a brief report of the case:

F. C., a somewhat anæmic, but otherwise healthy young woman, a seamstress, æt. 22 years, suffered from prolapse of the rectum to such an extent that simply standing in the erect position or at most a walk of twenty paces would cause the bowel to protrude in a conical mass

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of from four to six inches in length. The history of the onset of this
trouble is somewhat obscure, but the main facts are these: At the age
of ten years she suffered from a fall upon her back from a height of
about ten feet. There is no history of paraplegia, but the accident
was followed by incontinence of urine, and after about two years by
diarrhœa, which lasted more or less constantly for five or six years.
About five years prior to her admision to hospital the bowel began to
protrude at stool, but was easily returned. The tendency to prolapse
grew gradually worse, until it reached the condition already described.
The incontinence of urine had persisted and she had also very imper-
fect control of the sphincter ani, especially when the bowels were at
all relaxed and practically no control when diarrhœa existed. There
was also loss of sensation over the buttocks and posterior surfaces of
the thighs and calves, although there was no paralysis of the muscles
of the lower extremities. On examination, with the patient on her
back in a horizontal position with the thighs flexed upon the abdomen,
the sphincter was seen to be relaxed and lying open, so that drawing
the buttocks aside caused it to gape widely. Indeed, it had so little
contractile power that a man's hand, of ordinary size, could be easily
introduced. The prolapse seems, therefore, to have originated in
paralysis of the sphincter, due to the special injury received twelve
years previous to coming under observation. On May 22, 1890, the
bowels having been thoroughly evacuated, the patient was anæs-
thetized and a V-shaped piece was removed, having its apex at the
point of the coccyx, and its face consisting of the posterior part of the
sphincter ani from an inch and a half to two inches in length. An-
other V was then removed from the posterior part of the rectum
throughout its whole thickness having for its base the same portion of
the sphincter and its apex about four inches up the bowel. The
bleeding was free, but not troublesome nor alarming. The wound in
the bowel was closed by interrupted sutures of fine silk tied within the
bowel. The separated ends of the sphincter were brought together by
two strong silk sutures and another was inserted just below it. A
drainage tube was introduced at the point of coccyx and carried up
behind the line of suture in the rectum. For eight days there was a
considerable degree of inflammatory reaction with a temperature vary-
ing from 99° F. to 101° F., and on one occasion, only reaching 102°
F. After the eighth day the temperature remained normal and the
patient was free from pain. The sutures were then removed from the
sphincter and the drainage tube withdrawn, when a small sinus was
discovered, leading from the bowel just within the sphincter to the
opening which had been occupied by the drainage tube and through

which some fæcal matter passed in defecation. The patient had an excellent and uninterrupted recovery, and six weeks after the operation was allowed up. She was discharged on August 13, a little less than twelve weeks after operation, in better health than she had known for years, much better control of the sphincter and no longer any escape of fæces from the wound, although a small sinus still existed at the front of the coccyx through which a fine probe could be passed into the rectum just above the sphincter. This patient, at my request, again presented herself for examination on October 28. The wound had then completely healed, the control of the sphincter was good — much better than before operation, and the general health excellent. She stated that for two months she had been actively engaged in doing housework, going up and down stairs, etc., and that no sign of prolapse had ever been observed.

Such cases as the above are fortunately rare, but when met with I cannot think that cauterization, linear excisions, or even amputation (partial or complete), can prove an effective remedy. Ventral fixation of the sigmoid flexure, as carried out and described by Brigade Surgeon McLeod, of Calcutta, seems to have given satisfactory results, although there are theoretically heavy objections which might be urged against it. The operation recommended by Dr. Roberts, however, is sound in principle as well as safe and simple in practice, and as far as one can be justified in drawing conclusions from two cases, it seems to leave little to be desired.

SIMULTANEOUS DISTAL LIGATION OF THE RIGHT COMMON CAROTID AND RIGHT SUBCLAVIAN ARTERIES FOR SUPPOSED INNOMINATE ANEURISM[1]

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A FEMALE, partly Indian, partly Negro, æt. 38, presented herself at the Surgical clinic of the Woman's Medical College of Baltimore, in the latter part of the summer of 1889. For two years she has noticed a small pulsating lump at the root of the neck behind the right sterno-cleido-mastoid muscle. This lump increased slowly, accompanied with discomfort, oppression of breathing, more or less cough and hemicrania, and on account of these ailments, she applied for treatment. Upon inspection a pulsating tumor was seen, situated at the root of the neck, just above right-sterno clavicular articulation and raising the right sterno cleido-mastoid muscle with each impulse of the heart. The pulsating area appeared about the size of a small hen's egg. A distinct, but not very loud, bruit was heard over the tumor. There was no perceptible difference between the radial pulses, but the right carotid artery did not seem to beat so forcibly as the left. She was admitted to the Hospital of the Good Samaritan, where she was kept under observation, and the following additional facts learned in regard to her history. For a long time she has indulge to excess in the use of liquor, and has led a wild life. She has had five children, or premature births. She denied having contracted syphilis, but it is probable that she did, though there were no specially characteristic symptoms of the disease present The urine was increased in amount but did not contain albumen, nor did a microscopic examination re-

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[1] Read at the semi-annual meeting of the Medical and Chirurgical Faculty of Maryland, held at Cambridge, Md., Nov. 12 and 13, 1890.

veal casts. The heart sounds were normal, except that the second sound seemed to be a little accentuated. The lungs appeared to be healthy. There was no tracheal tug, which is sometimes present when the aorta is the seat of aneurism. My colleagues upon the medical side, Profs Cordell and Thomas, concurred in the diagnosis of innomina·e aneurism, but Prof. Thomas thought that the first portion of the subclavian and the arch of the aorta were also involved, as there was some thoracic dullness upon percussion. She was placed flat in bed and kept on very low diet, causing her to complain that she was being starved, and 10 grains iodide potash was given 3 times a day. She did not improve much under this treatment, which was continued for about six weeks. The lump seemed to become larger, and the choking, cough, oppression and headache increased. No treatment seemed to relieve these symptoms, but, on the contrary, they became worse ; severe epistaxis also occurred upon several occasions. As medical treatment had not yielded any good result, it was decided to ligate the right common carotid and the subclavian arteries. A few days previous to the operation, the patient went home on a visit and returned intoxicated almost to the verge of mania-a-potu. On November 29, 1889, the patient having been antiseptically prepared, the right common carotid was exposed by an incision along the inner border of the sterno-mastoid muscle. The neck was thick, and the artery placed deeply, which rendered this part of the operation rather tedious. The vessel was ligated with stout juniper oil catgut, below the omohyoid muscle, the internal jugular vein not being seen. Immediately upon tightening the ligature the heart's action became tumultuous and irregular and the tumor harder and larger. After waiting awhile for the heart to become quieter, the third portion of the subclavian was exposed by an incision along the clavicle, the fascia being torn through and the veins drawn aside. The artery was deeply placed, but was found without difficulty, and was tied externally to the scalenus anti cus muscle, catgut being used. Upon tieing the ligature the aneurism became smaller and softer, and the radial pulse immediately ceased, whilst the heart's action became more nearly natural. No cerebral symptoms supervened at any time. The arm was wrapped with cotton-wool and the neck padded with the same, after having closed the wounds with catgut and applied an iodoform and bichloride dressing. Within 24 hours the recurrent circulation was completely established, and a very small but distinct radial pulse could be felt. The temporal pulsation never returned. The temperature reached 101.2° on the evening of the second day, falling to normal the next evening. The pulse was increased in frequency at once, varying from 115 to 130 beats

per minute, and at the end of four weeks was still 100. 'The respiration was also accelerated for a long time. She was kept in bed on low diet for several weeks after the operation, and the aneurismal swelling seemed to diminish, but did not disappear. The wounds healed promptly without suppuration. For a while there was some numbness about the right arm, but this gradually disappeared.

I had the opportunity of examining this woman about one year after the operation, and she seemed to be cured; the lump, pulsation and bruit had almost entirely disappeared.

I place this case upon record as a contribution to the history of the distal ligation of the carotid and subclavian vessels for the relief of innominate and aortic aneurisms. Mistakes in the diagnosis of aneurism of the innominate or aorta have been very frequent in the past, and literature teems with cases of supposed aneurism of one or the other of these vessels, in which errors of diagnosis have been made; hence I am not sure that this woman was suffering from this affection, though the diagnosis was confirmed by expert diagnosticians.

Aneurism is always a formidable disease, and when it affects the innominate artery or the arch of the aorta its gravity is vastly greater than when more superficial vessels are attacked. This arises from the fact that the vessels are not only of great size, but from the impossibility of applying either pressure or the ligature between the heart and the tumor. Various methods of treatment have been instituted for the cure or relief of these affections, which may be classified as the medical and operative methods. Amongst purely medical measures may be mentioned the postural and dietetic, as exemplified by Tuffnell's method. This consists in the restriction of the patient's food and drink to the lowest point compatible with fairly comfortable living, and the observance of recumbency for a period of several weeks or months; this is often associated with the administration of iodide of potassium, or of tincture of digitalis. There can be no doubt that excellent results have followed these methods, either singly or combined, and a careful trial of such should always be made before subjecting a patient to an operation, if the rupture of the aneurism does not appear to be impending. There is consid-

erable divergence of opinion in regard to the utility of the
iodide of potassium in the cure of aneurism, and this diversity
is explained by Dr. G. W. Balfour (*London Lancet*, vol. i., 1886,
p. 356), as being due to improper administration of the drug.
He says the iodide should be administered every eight hours
in increasing doses, guided by its action on the pulse. If the
normal pulse rate is increased, the dose must be diminished.
First learn the pulse rate in recumbency, then give ten grains
every eight hours, increasing the dose by five grains every
week, if the pulse remains normal. It causes hypertrophy of
the aneurismal walls by lowering tension. Other methods of
treatment are the galvano-puncture, and the introduction of
wire, horsehair, or catgut into the sac through a canula. These
measures have not been attended with such success as to jus-
tify their frequent repetition. For many years occasional at-
tempts have been made to cure these aneurisms by the distal
ligation of one or both of the great trunks which arise from the
innominate artery, with variable success. We must, therefore,
study the results of the operations for purposes of comparison
under the following heads:

1. Ligature of right common carotid.
2. Ligature of right subclavian.
3. Ligature of left common carotid.
4. Consecutive distal ligature of right common carotid and
right subclavian, third part.
5. Simultaneous distal ligation of right common carotid
and right subclavian (third portion or axillary, first part).
6. Distal ligature of left carotid and left subclavian.

As elaborate papers have already appeared upon this sub-
ject by Dr. John A. Wyeth, of New York, in the *Amer. Jour.
of the Med. Sci.*, January, 1881, and by Rosenstern, of San
Francisco, in the *Archiv f. klin. Chirurg.*, 1886, p. 49, I will
avail myself of their statistics to a large extent in the prepara-
tion of the following tables:

TABLE I.—LIGATURE OF RIGHT COMMON CAROTID, ALONE.

Operator.	Number	Year	Vessel Involved.	Age	Sex	Result	Cause of Death.	Kind of Ligature used...	Antiseptic....	Remarks.
V. Mott.	1	1820	Innominate.	60	M.	D.	Secondary hæmorrhage.	?	No.	Died in 20 days.
Evans.	2	1828	Innominate and root of ca-rotid.	30	"	R.		"	"	Permanent cure, lived for 30 years, abscess and rupture of sac
Neumeister.	3	1829	Innominate.	51	"	D.	Cerebral complication. Died on 5th day.	"	"	
V. Mott.	4	1829	" and aorta.	51	"	R.	Pressure on trachea.	"	"	Died in 7 months from pressure of the con solidated aneurism of the trachea.
Key.	5	1830	" and aorta.	61	F.	D.	Cerebral aneurism in a few hours.	"	"	Left carotid nearly obliterated.
Morrison.	6	1832	" and root of ca-rotid.	42	M.	R.		"	"	Improved. Died suddenly 20 months later.
Scott.	7	1834	Innominate.			D.	Rupture of sac.	"	"	Died on 7th day.
Dohlhoff.	8	1837	"			"	Cerebral complications.	"	"	Died suddenly during some slight effort.
O'Shaughnessy.	9	1840	? aorta.	42	M.	"	Died on 10th day; rupture of sac.	"	"	
Hutton.	10	1841	Innominate.	47	"	"	Rupture of sac into trachea.	"	"	Died on 76th day. Secondary hæmorrhage and convulsions occurred.
Ferguson.	11	1841	" and root of right subclavian.	56	"	"	On 7th day.	"	"	Death the result of operation.
Porta.	12	1842	Innominate and roots of right carotid and subclavian.	60	F.	"	No cause given.	"	"	Died in 40 hours.
Rompani.	13	1844	Carotid and innominate.	70	M.	"	Secondary hæmorrhage.	"	"	Died on 21st day. Double aneurism of ca-rotid and innominate.
Campbell.	14	1845	Innominate.	48	"	"	Suffocation from pressure.	"	"	Died in 19 days.

	No.			M.	D.			
Vilardebo.	15	?	Double aneurism of right ca-rotid, right subclavian and innominate.				?	Died on 21st day.
Wright.	16	1855	Innominate.	70	"	Abscess of the brain.	"	Lived nearly 3 months.
Ordite.	17	1859	"		"		"	No particulars given.
Broadbent.	18	1860	"	50	R.		"	Died in 4 months.
Pirogoff.	19	1860	"	?	"		"	Improved, and lost sight of.
Nussbaum.	20	?	"		D.	Growth of aneurism.	"	
Nussbaum.	21	?	"		"		"	
Butcher.	22	1863	Dilatation of innominate an-eurism of 1st part subclavian	42	"	Death in 88 hours.	"	Innominate and 1st part of subclavian enormously dilated.
Hutchison.	23	1867	Aorta, innominate and right caroid & right subclavian.	48	"	Death in 41 days from suffo-cation.	"	Also attempted to tie right subclavian, but the vessel was not included in the ligature
Hewson.	24	1867	Aorta and innominate.	51	"	Died on 10th day. Asphyxia from pressure.	"	
Annandale.	25	1875	Aorta.	62	R.	Died on 10th day.	Yes	Patient very much improved.
Bryant.	26	1877	"	56	D.	Died on 10th day.	Catgut.	Operation had done no good.
Reyher.	27	1879	Innominate.	52	R.	Died in 40 hours; œdema of lungs.	"	Improved.
Küster.	28	1879	"		D.		"	"
Bryant.	29		"		R.			"
Kuster.	30		"					
Golding Bird.	31	1883	"	28	D.	Died in 6 days.	Chromic gut,	Retropharyngeal abscess.
Ferguson.	32	1884	"	43	R.			Œdema of lungs; died 2 years later.
Ashhurst.	33	?	Aortic.		"			No improvement.

TABLE II.—LIGATURE OF RIGHT SUBCLAVIAN ALONE.

Operator.	Number	Year	Vessel Involved.	Age.	Sex.	Result.	Cause of Death.	Kind of Ligature used..	Antiseptic....	Remarks.
Wardrop.	1	1827	Innominate.	41	F.	R.			No.	Died 2 years and 2 months later.
Langier.	2	1834	"	57	M.	D.	Secondary hæmorrhage.			Died in 1 month, bleeding from peripheral end of subclavian.
Broca.	3	1862	"	50	"	R.				Died in 6 months from gangrene of the lung.
Lane.	4	?	"	?	"	D.				Died in 8 days.
Bryant.	5	1871	"	33	"	R.		Carbol. catgut		Died in 3 years from pressure of the aneurism.

TABLE III.—LIGATURE OF LEFT COMMON CAROTID ALONE.

Operator.	Number	Year	Vessel Involved.	Age.	Sex.	Result.	Cause of Death.	Kind of Ligature used...	Antiseptic...	Remarks.
Montgomery.	1	1829	Aorta.	40	M.	R.			No.	Improved, but died in 4 months from hæmorrhage.
Tillanus or Rigen.	2	1829	"	?	"	"			"	Improved, but died in 5 months from asthma and spasm.
Pirogoff.	3	?	"	?	"	"			"	Left hospital in 2½ months very much improved.
Pirogoff.	4	?	Innominate and aorta.	?	F.	D.	Death in 3 weeks			Hemiplegia.

Operator	Number	Year	Vessel Involved.	Age.	Sex.	Result.	Cause of Death.	Kind of Ligature used.	Antiseptic.	Remarks.
Heath.	5	1872	Aorta.	48	M.			Catgut.	Yes	Great relief, died 4½ years after operation.
Heath.	6	1874	"			D.	Death in a few hours from cerebral aneurism.			Right carotid had been previously obliterated.
Holmes.	7	1875	End of arch of aorta.	21	F.	R.			"	Alive 7 months later.
Barwell.	8	1877	Transverse aorta.	56	M.	"			"	Improved, and died in 4 months of kidney disease.
Dauchez.	9	1879	Aorta mistaken for carotid.			"				Improved, but died in 13 months.
Hardie.	10	1880	Transverse aortic.			"		Carbol. silk.		Died 6 years later. Ligature unchanged.
Pryant.	11	1881	Innominate.			D.	Died on 19th day.	Catgut.		Operation increased the growth. Death from pulmonary œdema and gangrene.
Ashhurst.	12	?	Aorta.			R.				Improved for a while.
Heath.	13	1890		38	M	"	Died in 2 months.			Cocaine anæsthesia.

TABLE IV.—CONSECUTIVE DISTAL LIGATION OF THE RIGHT COMMON CAROTID, AND RIGHT SUBCLAVIAN THIRD PORTION.

Operator	Number	Year	Vessel Involved.	Age.	Sex.	Result.	Cause of Death.	Kind of Ligature use l...	Antiseptic....	Remarks.
Wickham.	1	1827	Innominate.	55	M.	D.	Rupture.	Silk.	No	Died of pleurisy—alcoholic.
Fearn.	2	1836 1838	"	28	F	R.	Died 4 months after last operation.	"	"	Greatly improved.
Malgaigne.	3	1845	"	46	M.	D.	Rupture of sac 21 days, after operation.			Alcoholic.
Bickersteth.	4	1864	Aorta and innominate.	35	"	R				Died in 3 months from the progress of the disease.
Speir.	5	1874	Aorta supposed innominate.	31	"	D.	Rupture of sac on 34th day.			Speir's constrictor to carotid; 48 hours later tied subclavian.

TACLE IV.—CONTINUED.

Operator.	Number.	Year.	Vessel Involved.	Age.	Sex.	Result.	Cause of Death.	Kind of Ligature used...	Antiseptic...	Remarks.
Doughty and Mott.	6	1875 1876	Innominate.	40	M.	R.				Greatly improved. Died of phthisis 3 years after operation.
Küster.	7	1879	Aorta.	37	"	"		Carbol. catgut		Died 3 months after last operation, wounds healed.
Adams and Treves.	8	1885	Innominate.	47	"	D.	Died 37 days after last operation; rupture of sac.	Catgut.		Carotid not obliterated, subclavian obliterated.
Wolf. Schede.	9 10	1882 ?	Aorta. "	32 9	" "	R. D.	Secondary hæmorrhage.	Silk.		Died 5 months after last operation.
Gay.	11	?	Innominate.	38	"	R.		"		Great improvement. Died 1 year later, ligated carotid and 2 months later subclavian.

TABLE V.—SIMULTANEOUS DISTAL LIGATION OF RIGHT CAROTID AND RIGHT SUBCLAVIAN.

Operator.	Number.	Year.	Vessel Involved.	Age.	Sex.	Result.	Cause of Death.	Kind of Ligature used ..	Antiseptic...	Remarks.
Hobart.	1	1839	Aorta mistaken for innominate	25	F.	D.	Died on 16th day; hæmorrhage from carotid.		No.	Common carotid tied 1 inch above origin. Subclavian in 1st part.
Rossi.	2	1844	Innominate.			"	Died on 6th day. Left carotid and right vertebral obliterated.		"	As the left vertebral was the only vessel to carry on the cerebral circulation, he probably died of anæmia of the brain.

Name	No.	Year	Diagnosis	Age	Sex	R./D.	Result	Ligature	Cured	Remarks
C. Heath.	3	1865	Aorta mistaken for innominate.	30	F.	R.			?	Great improvement. Died from external bursting of an aortic aneurism, 4 years and 17 days after the operation.
Maunder.	4	1867	Aorta mistaken for innominate.	37	M.	D.	Died on 5th day; occlusion of aorta by clot.		"	Clot projected from innominate into aorta.
Hodges.	5	1868	No true aneurism.	55	"	"	Died on 12th day; exhaustion.		"	Fusiform dilatation of innominate and aorta, but no true aneurism.
Sands.	6	1868	Aorta mistaken for innominate.	43	F.	R.	Died in 13 months.	Silk or thread	No.	Tumor diminished and visible pulsation ceased.
Jas. Lane.	7	1871	Innominate and aorta.	40	"	"	Died in about 50 days from bursting of sac.	Silk.	Yes	Improved and left hospital in 46 days. Death suddenly about 50th day.
Holmes.	8	1871	"	40	M.	"	Died on 55th day; œdema and exhaustion.	Catgut.	"	One month after operation galvano puncture, later sac opened with knife.
McCarthy.	9	1872	" and aorta.	45	"	D.	Died on 16th day from hæmorrhage.	Silk.	"	Bleeding from subclavian ulceration at seat of ligature.
Durham.	10	1872	"	9	"	"	Died on 6th day; apparently from shock.	"	"	Ligated subclavian, first the carotid.
En-or.	11	1874	"	50	"	R.	Died on 65th day from rupture of aneurism.	"	"	Progressed favorably. Exposed himself and contracted rheumatism. Aneurism ruptured below carotid ligature.
Weir.	12	1876	"	45	"	D.	Died on 15th day from rupture of aneurism.	Catgut	"	Pulsation returned in right temporal in 2 hours and in radial in 6 hours.
Elliott.	13	1876	"	41	"	"	Died on 26th day; hæmorrhage from sac.	Silk.	"	Ulceration of tumor. Rupture of aneurism.
King.	14	1876	"	37	"	R.	Death on 11th day from rupture of aneurism.	Catgut.	"	Much improved. Got on a spree and died of hemorrhage.
Little.	15	1877	"	46	"	"	Death from pleurisy 3 years and 4 months after operation	"	"	Subclavian tied first. Permanently cured Death not connected with operation.
Barwell.	16	1877	Aorta and innominate.	45	"	"	Death from broncho-pneumonia in 100 days.	"	"	Ligature of carotid, and 24 hours later subclavian. Aneurism cured.
Barwell.	17	1877	"	37	F.	"	Death in 19 months from bronchitis.	"	"	Great improvement in February, 1879. Married in Feb., 1879.

TABLE V.—CONTINUED.

Operator.	Number	Year	Vessel Involved.	Age	Sex	Result	Cause of Death.	Kind of Ligature used	Antiseptic	Remarks.
Barwell.	18	1877	Innominate.	48	M.	D.	Died 30 hours probably from the anæsthetic.	Catgut.	Yes	Patient never recovered from the ether, remained cyanosed.
Barwell.	20	1879	"	48	"	"	Died on 7th day. Asphyxia.	Carbol. a silk.	"	Fusiform dilatation of arch of aorta, and aneurism of innominate.
Barwell.	21	1879	Aorta.	36	"	R.	Died in 15 months of a new aneurism.	Flat ox Aorta. ligature	"	Great improvement, lived 15 months in comfort, original aneurism completed cured.
Ransohoff.	19	1878	Innominate.	27	F.	"		Catgut.	"	Great improvement Still alive when reported.
Stimson.	22	1880	"	34	M.	"		"	"	Cured Died of phthisis 21 months after operation. Aneurism cured.
Palmer.	23	1880	" and aorta.	50	F.	"	Died in 4 months of hæmorrhage.	Hemp.	No.	Aneurism filled with laminated clot, communication innominate and vein, opening into trachea.
Lediard.	24	1880	Aorta.	42	M.	"	Died 11 mo. after operation.	Lig. ox. aorta.	"	Great improvement, aneurism filled with hard clot at autopsy 11 months after operation.
Wyeth.	25	1880	"	42	F.	"	Died 1 year later Acute diarrhœa.	"	"	Great improvement; almost cured but a small cavity remained. Woman addicted to drink.
King.	26	1880	Root of neck.	40	M.	"	Living when reported	Antiseptic silk.	"	Dismissed 8 weeks after operation; aneurism smaller and patient free from pain.
Marsh.	27	1881	Aorta.	30	"	D.	Ruptured on 51st day.	Chromic catgut	Yes	Rapid enlargement of aneurism to left after operation.
Pollock.	28	1881	Innominate.	37	"	"	Dysphœa.	Catgut & tendon.	"	Catgut ligature for caroid, Kangaroo tendon for subclavian.

Name	No.	Year	Aneurism	Age, Sex	Result	Course	Ligature	Cured	Remarks
Langley—Brown.	29	1881	Innominate.	32 M.	R.		Chromic catgut	Yes	Improved. Living 2 years later.
Cameron.	30	1882	"	57 F.	"		Catgut.	"	Alive and well 20 months after operation.
Lane.	31	1882	"	? M.	"	Died in 10 months.	Carbol. silk.	"	Marked relief, returned to work; died after 10 months.
v. Bergmann.	32	1883	"	40 "	"		"	"	Improved, rapid healing, decrease in size.
May.	33	1883	"	40 "	D.	Died in 2 days from cyanosis.	Catgut.	"	Tied axillary, 1st part and carotid.
Rosenstern.	34	1883	"	42 F.	R.		Silk.	"	Ligatures on carotid separated in 5 or 6 weeks. On subclavian in 3 months. Great improvement. Alive and at work 2½ years later.
Gerster.	35	1884	"	51 M.	"		Catgut.	"	Tied axillary, 1st part, then carotid.
Barwell	36	1884	"	?48 F.	"		Ox aorta.	"	All pulsation disappeared and patient seemed cured 6 months later.
Banks.	37	1884	"	? M.	D.	Died in 1 month. Hæmorrhage from subclavian.	Kangaroo tendon lig.	"	Aneurism nearly filled with laminated fibrin.
Alexander.	38	1882	" and aorta.	48 F.	R.	Died in 6 months. Dyspnœa.	Catgut.	"	Some relief.
Beany.	39	?	"	?	"				Mentioned by Barwell in Article Med. Chir. Trans. 85, vol. lxviii, p. 124.
Beany.	40	?	"	?	"				"
Hartley.	41	1885	Innominate.	M.	D.				Improved; patient exhibited Nov. 16, 1888. Aneurism extending.
Jessup.	42	?	"		R.	Hæmorrhage on 49th day.	Silk.		Reported by Mr. Ward.
Jessup.	43	?5	"		"		Catgut.		Aneurism not cured.
Jessup.	44	?	"		"		Silk.		Secondary hemorrhage, stopped by galvano puncture.
Jameson.	45	?	Aorta simulating innominate.	59 M.	"			No.	Result, 3 months freedom from pain.
Lawrie.	46	1885	Aorta.	38 "	"		Carbol. silk.	Yes	Much improved 4 months subsequently.

TABLE V.—CONTINUED.

Operator	Number	Year	Vessel Involved	Age	Sex	Result	Cause of Death	Kind of Ligature used	Antiseptic	Remarks
Præger.	47	1886	Innominate.	60	M.	R.	Death from bronchitis 1 year p.-operationem.			Hemiplegia 2 days after operation, same day slight pulse in radial.
McBurney.	48	1886	"	35	"	"		Catgut.	Yes	Alive and apparently cured 18 months subsequently.
Ashhurst.	49	1886	"	42	"	"		"		Discharged 2 months subsequently.
Mynter.	50	1887	"	54	F.	"		"		Much improved.
Heath.	51	?	"	?	"	"		?		Discharged improved on 51st day.
Percival.	52	?	"	?	"	"		Chromic gut.	?	Marked improvement; antimony post-operationem seemed to be of benefit.
Wells.	53	?	Aorta.	70	F.	"		Catgut.		Apparently complete cure.
Dunlap.	54	?	Innominate.		"	"				Almost a cure, much improved.
Dunlap.	55	1888	"			?				Doing well when reported.
Packard.	56	1888	"	26	M.	D.	Suffocation, 5th day.	Catgut.		Aneurism the result of injury.
Meriwether.	57	1888	Aorta.	35	F.	R.		"		On 27th day no pulsation; considers her self cured.
J. C. Warren.	58	1889	Innominate.	50	M.	"	Death in 3 months from rupture of aneurism.	Braided silk.		Tied 1st portion axillary between 2 portions pectoralis major.
Winslow.	59	1889	Supposed innominate.	38	F.	"	Still living	Catgut.	Yes	Wounds healed p.-p.; pulsation not arrested
Pettus.	60									Have not been able to come across report of this case.
Ashhurst.	61	1889	Aorta.	49	M.	R.		Catgut.	Yes	Aneurismal symptoms much improved.

TABLE VI.—CONSECUTIVE LIGATURE OF LEFT CAROTID AND LEFT SUBCLAVIAN OR LEFT AXILLARY.

Operator.	Number.	Year.	Vessel Involved.	Age.	Sex.	Result.	Cause of Death.	Kind of Ligature used...	Antiseptic...	Remarks.
Schede.	1	?	Arch of aorta.	34	M.	R.			Yes	Great improvement, died suddenly in 6 months.
Busch.	2	1880	Two aneurisms of aorta.	45	M.	D.	Died on 4th day.		"	First part of axillary tied. Operation of no benefit.

TABLE VII.—SIMULTANEOUS LIGATION OF LEFT CAROTID AND SUBCLAVIAN.

Operator.	Number.	Year.	Vessel Involved.	Age.	Sex.	Result.	Cause of Death.	Kind of Ligature used...	Antiseptic...	Remarks.
Wyeth.	1	1886	Aorta involving roots of left carotid and left subclavian.	48	M.	D.	Died in 72 hours.	Catgut.	Yes	

TABLE I.—DISTAL LIGATURE OF THE RIGHT CAROTID, ALONE.

Number of cases, 33; recovered, 11; cured, 1; improved, 7; died, 22.

Cause of death: Secondary hæmorrhage, 2; cerebral complications, 4; rupture of sac, 3; pressure, 4; œdema of lungs, 1; retro-pharyngeal abscess, 1; doubtful, 5.

Pre-antiseptic cases, 24; recovered, 5; cured, 1 (this patient lived for 30 years after the operation); died, 19.

Antiseptic, 9; recovered, 6; cured, 0; died, 3.

Males, 22; females, 2; unknown, 9.

TABLE II.—LIGATION OF RIGHT SUBCLAVIAN, ALONE.

Number of cases, 5; recovered, 3; cured, 0; improved, 3; died, 2.

Cause of death: Secondary hæmorrhage, 1; not stated, 1. One patient lived three years, one, two years and two months, and one only six months.

Males, 4; females, 1.

TABLE III.—DISTAL LIGATION OF THE LEFT COMMON CAROTID, ALONE.

Number of cases, 13; recovered, 10; apparently cured, 2; improved, 7; died, 3.

Cause of death: One case from hemiplegia in three weeks, one from cerebral anæmia in a few hours, and one from pulmonary œdema and gangrene.

Pre-antiseptic cases, 4; recovered, 2; died, 2.

Antiseptic, 9; recovered, 7; apparently cured, 2; died, 2.

Males, 6; females, 2; unknown, 5.

TABLE IV.—CONSECUTIVE LIGATION OF RIGHT COMMON CAROTID AND RIGHT SUBCLAVIAN, THIRD PORTION.

Number of cases, 11; recovery from operation, 6; cured, 1; improved, 4; died within 40 days, 5.

Cause of death: Rupture of sac, 4; secondary hæmorrhage, 1. Spier's constrictor was used in one case to carotid, and 48 hours subsequently the right subclavian was ligated. The patient died 34 days later from rupture of the sac.

Males, 10; females, 1.

TABLE V.—RESULTS OF SIMULTANEOUS DISTAL LIGATION OF
THE RIGHT COMMON CAROTID AND RIGHT SUBCLAVIAN,
THIRD PORTION, OR AXILLARY, FIRST PORTION.

Total cases, 59; recovered from operation, 43; apparently
cured, 16; improved, 20; died, 16.

Antiseptic, 53; recovered, 41; apparently cured, 16; died, 12.
Pre-antiseptic, 6; recovered, 2; died, 4.

Ligature material, silk or thread, 20; recovered, 10; died, 10.

Cause of death: Hæmorrhage, 4; cerebral anæmia, 1; occlu-
sion of aorta, 1; exhaustion, 1; shock, 1; asphyxia, 1.

Catgut, 26; recovered, 20; apparently cured, 8; died, 6.

Causes of death: Hæmorrhage, 0; rupture of sac, 2; anæs-
thetic, 1; cyanosis, 1; suffocation, 1; dyspnœa, 1.

Ox aorta, 4 cases; 4 recoveries; apparently cured, 3.

Males, 34; females, 16; unknown, 10.

Amongst these cases are included one in which the first
portion of the right subclavian was tied, death resulting on the
sixteenth day of hæmorrhage, and three in which the vessel
was tied below the clavicle (first portion of axillary, English,
third portion of subclavian, German); with one death on the
second day from cyanosis, and two recoveries.

TABLE VI.—LIGATIONS OF LEFT COMMON CAROTID AND LEFT
SUBCLAVIAN OR AXILLARY.

Consecutive, carotid and subclavian.—Number of cases, 1;
recovered, 1; improved, 1.

Carotid and axillary: Number of cases, 1; died on fourth
day.

Simultaneous carotid and subclavian: Number of cases, 1;
died in 72 hours.

Males, 3; females, 0.

The cases here tabulated are not supposed to be all that
have been operated on, but they are all that have been acces-
sible to me for purposes of study aud comparison, and they
are sufficient in point of numbers for the elucidation of the
main features involved. I have not attempted to tabulate sep-
arately the results of operations for the relief of aneurisms of
the arch of the aorta, but have included aortic and innominate

aneurisms together.   This would, perhaps, not have been the best procedure, but as the mistakes in diagnosis have been very numerous, and usually only discovered upon post-mortem examination, it is probably not a matter of much moment. A noticeable feature in this inquiry is the very much greater proportion of aneurisms affecting the male sex than the female; of the 98 cases in which operations were performed, and the sex recorded, 76 were male, and 22 female.   This is in accordance with the well known law that aneurism is most frequent in the male sex, which the elder Gross attributes not so much to the more laborious occupations of men, as to the fact that women are not so prone to arterial degenerations.   A glance at the histories of these cases also shows a very large proportion of habitual topers; and the fatal result in not a few cases is directly traceable to the evil effects of a debauch. The ages of those subjected to operation varied from 21 to 70 years, which classified in decennial periods is as follows: From 21 to 30, 5 cases; 30 to 40, 22 cases; 40 to 50, 34 cases; 50 to 60, 19 cases; 60 to 70, 5 cases; over 70, 4 cases.

We will see by reference to the tables that the simultaneous distal ligation of the right common carotid, and the right subclavian arteries has been performed much more frequently than any other operation for the cure of these aneurisms, and with a much larger proportion of recoveries, $72^3/_4\%$, as compared with $54^1/_2\%$ in the consecutive distal ligation of the same vessels.   Distal deligation of the right common carotid alone gives a percentage of recoveries of only $33^1/_3$, whilst the ligation of the right subclavian alone, which has only been performed five times, gives a proportion of 50% of recoveries. The left common carotid artery has been tied thirteen times for aortic aneurism, with a proportion of recoveries of nearly 77%, and with very great improvement in the patients, but this operation is only applicable to aneurisms affecting the summit and left extremity of the arch of the aorta.   If we analyze the cases more carefully we shall find that the results have been materially modified by the introduction of antiseptic methods.   As we cannot state definitely in every case whether the operation was conducted upon antiseptic principles or not, we will have to satisfy ourselves with referring to

those cases which occurred before 1871 as pre-antiseptic, and those since as antiseptic operations, and we will find a most remarkable difference in the behavior of the two classes of cases. In the antiseptic simultaneous ligations of the right carotid and subclavian, the recoveries amount to $77^1/_3\%$, in the pre-antiseptic cases only $33^1/_3\%$ recovered. In the antiseptic distal ligation of the right common carotid artery, alone, the proportion of recoveries was $66^2/_3\%$; in the pre-antiseptic, $20^3/_4\%$. In the antiseptic distal ligation of the left common carotid, $77^3/_4\%$ recovered; in the pre-antiseptic, 50%. The best permanent results are also found to belong to the simultaneous distal ligation of the common carotid and subclavian of the right side, though Mr. T. Holmes thinks that about all the good which is obtained is to be had from ligation of the carotid first, and if necessity should occur, subsequently, the subclavian. Very interesting questions are raised in regard to the action of different kinds of ligatures when applied to these large vessels.

The early operations were performed without antiseptic precautions, and silk or hemp ligatures were used. This involved a more or less tedious convalescence, with suppuration, in those cases which recovered; and not unfrequently death from secondary hæmorrhage occurred upon the separation of the ligature. Of the operations performed within antiseptic times, for the ligation of the right common carotid and right subclavian, simultaneously, in 14 cases silk or thread was used, with 9 recoveries and 5 deaths, only one of the deaths, however, being from secondary hæmorrhage. In 26 cases catgut was used, with 20 recoveries and 6 deaths, none of the fatal cases resulting from secondary hæmorrhage. In 4 cases the flat ox aorta ligatures were used, all recovering; and in 2 cases kangaroo tendon was the ligature material, both terminating fatally. The number of observations recorded is too small for making any special generalization, but they are suggestive. There can be no doubt that a person is more exposed to the danger of secondary hæmorrhage when a non-absorbable ligature is used, than when catgut or other absorbable material is made use of; but silk is more easily and effectively sterilized than an animal material. On the whole,

however, an absorbable material secures more favorable results, and the question is more in regard to the particular animal tissue to be used, and the shape of the ligature. Barwell has especially eulogized the flat ligatures made from the aorta of the ox, and they have given satisfaction wherever used. His idea in introducing these ligatures was that the coats of the artery would not be cut through by the broad, tape-like ligatures, but that the circulation would be effectively shut off for a sufficient time to allow consolidation of the aneurism; and the ligatures would then be absorbed, leaving the artery simply closed by a diaphragm, where its walls had been in contact. Whilst good results have resulted from the use of this ligature, it is doubtful whether it possesses any advantage over ordinary stout, round catgut, and it seems to me to be pretty well proven that the best and safest way of occluding an artery is by constricting it with sufficient force to divide its inner coats and thereby cause complete severance of the continuity of the vessel. I think, therefore, that properly prepared catgut is the most available as well as the best ligature material to be used in these cases. Kangaroo and other tendinous ligatures are too difficult to obtain for general use, and do not seem to me to present any commensurate advantage. In one case Dr. Speir successfully occluded the right carotid artery with his "constrictor," and 48 hours later tied the subclavian. This was essentially a simultaneous operation, but is not included in the table of similtaneous ligations. If it were not for the fact that the use of a catgut ligature leaves but little to be desired, a further trial of Speir's "constrictor" might be made with advantage.

In looking over the causes of death, I find 7 cases in which the fatal result is definitely attributed to secondary hæmorrhage, and of these four in which the vessel was tied with silk or hemp, and 1 with kangaroo tendon. Bursting of the sac, either internally or externally, is by far the most frequent cause of death, occurring in from 10 days to 4 months after the operation. This is the natural tendency of all aneurisms, and it is remarkable that the sudden strain which is thrown upon the sac by the ligation of the great vessels coming from it, does not more frequently cause its rupture. Amongst the

causes of death, we find "cerebral complications" occupying quite a prominent place. This is not to be wondered at, considering the sudden anæmia which is produced by the ligation of the common carotid, which, however, quickly passes off. In some cases several of the trunks leading to the brain have been previously obliterated, and the ligation of one of the remaining vessels produces such a degree of anæmia as to cause death. The ligation of the subclavian alone would naturally be supposed to favor cerebral embolism, but in the 5 cases in which the right subclavian has been ligated alone, no such result followed. Pressure symptoms belong to the natural history of aneurism, and we find that many succumb after operations to pressure on the trachea, bronchi, or lungs, producing cyanosis, dyspnœa and asphyxia, or œdema and gangrene of the lungs. In one case death is said to have been caused by the occlusion of the aorta, by a clot which projected from the innominate; this occurred on the fifth day *post-operationem*. One death is attributed to post-pharyngeal abscess, which was probably the result of infection at the time of the operation. In conclusion it may be stated that simultaneous distal ligation of the right common carotid and right subclavian artery, in its third portion, has not, *per se*, a very high rate of mortality, when performed antiseptically, with an absorbable ligature; and that in a large proportion of cases great benefit will follow, whilst in a small proportion of cases a permanent cure will be obtained.

THE PROPRIETY OF, AND THE INDICATIONS FOR, THE RESECTION OF THE APPENDIX VERMIFORMIS DURING THE QUIESCENT STAGE OF CHRONIC RELAPSING APPENDICITIS.

By JOSEPH PRICE, M. D.,

OF PHILADELPHIA.

THE question of the propriety of operation during the quiescent stage of a chronic relapsing appendicitis, is one that has to be argued, after the manner of the old adage, of "Locking the stable after the horse has been stolen." In the discussion of the indication for early operation for appendicitis if the decision is reached, as I think it should be, that surgical interference, in the absence of general complications, in experienced hands is, or ought to be uniformly safe, we are, in this discussion, left to the consideration of a part of the subject of a condition that ought not to obtain at all, because the pathology that renders it possible ought not to exist. Dr. Fitz, in his classic paper of 1886, in the Transactions of American Physicians, says: "An additional argument against the plan of waiting with the hope of the occurrence of resolution, is to be found in the frequency of recurrent attacks." He then places the recurrence at 11%. The tables of Kraaft are double this, or 22%. Now when we consider the anatomy of the parts concerned in the occurrence of appendicitis it is evident that many so-called instances of the affection are not appendicitis at all, but are examples of simple inflammatory adhesion due to congestion from the extreme mobility and twisting of the colon under the several varieties of revolution in this special portion of the intestinal canal as demonstrated by Rokitansky. The per cent of

real recurrence must therefore be still greater. Now inflamma-
tions of this sort, like adhesive inflammations elsewhere in the
intestinal tract, may cause inflammation and pain, though they
are not appendicitis at all. Cases of appendicitis that get well
without evidence of severe lesion, or any tendency to recur,
are always open to the doubt of being appendicitis at all. The
recurrent cases must be regarded as entirely typical of the
disease, and the history of their complications that which
should determine the question of our action or inaction in a
condition which is often the most murderous of surgical af-
fections.

That concretions may exist in the appendix without giving
rise to serious trouble is no argument against the general rule
that ordinarily they do cause suppuration. We have it stated
by the opponents of operation in relapsing peritonitis that
even in the event of perforation and the occurrence of general
peritonitis recovery may occur without laparotomy. Such an
argument certainly is without sufficient general applicability to
merit its serious acceptance. On the same ground a city gov-
ernment might decide that inasmuch as small fires, even
though allowed to spread, may yet be self limiting, and pro-
duce no damage which the municipality and the individal pro-
prietor might not recover from, therefore that its fire depart-
ment be not called out save in the event of a general con-
flagration. The surgery that waits for a general peritonitis
before it interferes with a condition that may cause it or hesi-
tates to operate upon a patient suffering from a general
peritonitis because it *is possible for recovery without opera-
tion*, lends itself to a conspiracy both against the science of
real surgery and against the sanctity of human life. It is the
procrastination that is the thief of time, and against life, for
that is the stuff that life is made of. It matters not that one
or two or ten cases may be cited in which various pathologi-
cal conditions of the appendix may be cited in which perfora-
tion has occurred without fatal termination. The expediency
of operation must be tested, not by these but by the results of
operations done for relapse and before its occurrence for
primary disease, without serious complication. Operation
done *in extremis* after numerous recurrences and in the pres-

ence of serious complications, or in extreme prostration, cannot be cited as arguments against the procedure because they fail to save life. They must rather be quoted against the delay that makes their necessity an opprobrium of surgery. Now granting that numerous cases in which suppuration occurs in chronic recurring appendicitis finally result in cure, can this be reasonably held as an argument against operation? I think not. We have to place against prompt surgical relief, before suppuration has taken place, the dangers of long continued suppurative processes, the details of which it is not necessary to recite. Suppurative destruction of any other abdominal or indeed of any organ are promptly dealt with. The surgeon who would allow a pleurisy to remain week after week until it had become purulent, before evacuating it, would scarcely expect to have his delay meet the approval of progressive physicians. An abscess of the liver must not be allowed to remain, nor that of the kidney nor that of the brain, and yet in all seriousness we are asked to consider that an abscess of the appendix if it is allowed to mature, *can sometimes be expected to proceed to favorable resolution; and that a peritonitis therefrom derived may sometimes fail to kill the patient;* and that therefore we need not always operate to relieve him. We would not use such logic in any business transaction. Is it fair to introduce such reasoning into practical surgery.

The most important paper of the past year so far as I have discovered is that of Dr. Dennis, of New York, who decides against the operation for the following reasons:

1. The danger to human life.

2. The difficulties of a positive diagnosis.

3. The development of ventral hernia.

4. The lack of conclusive evidence that excision of the appendix is attended with permanent relief.

5. The result of relapsing attacks may afford immunity from danger in the future.

I quote these conclusions as representing possibly all that the opponents of the operation can reasonably urge against it, in order briefly to consider the objections which it is evident are not manufactured for the sake of destroying, but which are put forth as a creed upon which to found a surgical faith,

which we are, I believe, justified in questioning before receiv-
ing it as orthodox.   The danger to human life, it must be re-
membered, is increased by the logical antecedent of the ulti-
mate proposition for delay.   First we have it urged do not
operate because only a minority of the cases recur, and most
get well without operation; then we are urged in recurrence
not to operate because few recurrences kill; finally we are ad-
vised there is no real need to operate even in peritonitis from
recurrence, because peritonitis does not always kill.   Such
logic makes surgery as uncertain as the prophecies of the
weather, and are as little to be relied upon.   That an opera-
tion in order to be uniformly successful requires a refined
technique, is no argument against the performance of that
operation.   In the best hands it is the opinion commonly re-
ceived that operation for simple removal of the appendix is
uniformly safe.   In the existence of complications, the neces-
sity for careful surgery with an abdominal experience is not
to be overlooked.   General surgeons with the idea that ab-
dominal surgery needs no special care or special preparation,
cannot fairly quote their results, if unsuccessful, against the
adoption of the operation.   All the complications liable to
occur in this operation are just as liable to be met in other
abdominal surgery, and the dangers of these diminishes as ex-
perience grows.   The adhesions of an appendicitis cannot
compare in complexity to those of an ectopic pregnancy, and
yet who will advise this latter condition to be left to find its
cure in suppuration? Positive diagnosis is not waited for in any
other condition in which danger is imminent in the abdomen.
A simple exploratory incision is not to be feared as fatal, and
when it is so, there has been something wrong in the technique
of the operator, something faulty in his idea of what consti-
tutes simple exploration.   If hernia is to be taken as an argu-
ment against the late operation for appendicitis, it is much
rather to be taken as an argument against the delay which
makes a late operation merit a serious consideration.   In es-
caping one horn of the dilemma, we cannot find peace on the
other.   When we consider that the appendix in the great
majority of cases is the seat of all inflammation at the head of
the colon, the question of the value of its removal as a meas-

ure for permanent relief must be regarded more as technical
or as critical, than as important. In any other region if we
decide that there is a cause for a pathological condition, it is
not questioned that this cause, if possible, should be removed.
If the disease again recurs, other cause is to be sought. If
the lesion is in the cæcum, it is folly to remove the appendix
for that lesion. I am not sure that it would be bad surgery to
remove it without cause present in order to escape a possible
future contingency.

A final argument that relapsing attacks may afford immu-
nity from future attacks might be adduced as a proof that
operation in other conditions of pelvic peritonitis may not be
necessary, because successive attacks may limit the territory
of the disease, which may thus be said to burn itself out. All
abdominal surgeons have met cases in which after protracted
suffering with free discharge of pus, the patient after many
years of delay reaches a condition of comparative comfort, in
which it would be unwise to interfere. All this tends to the
general criticism of general rules against a special operation,
because in order to receive them as decisive they must lose all
suspicion of special pleading.

The cases of Dr. Stimson published in the *N. Y. Med. Jour.*,
Oct. 25, 1890, are worthy of a careful study as exhibiting the
logic of the tactics variously proposed in the treatment of this
condition. Of eight cases not operated upon, two, or 25%
died; of three cases treated by the simple evacuation of pus
all recovered; of ten cases in which the general peritoneal
cavity was opened, two, or 20% died; of these latter one died
in the second attack after operation, the other in the first. It
is worthy of careful attention here that recurrence, as proven
by Dr. Fitz' cases as recorded p. 40, Transactions of Ameri-
can Physicians, 1890, is 44%. In Dr. Bridge's paper in the
same volume, the conclusion is reached that surgical interfer-
ence is warranted in cases of undoubted appendicitis, even if
no induration is present. In all of Dr. Fitz' cases, he gives
his decision that in at least five-eighths, the treatment should
have been surgical. If this is true of primary and relapsing
cases in the aggregate, it would seem that of relapsing cases
the number would be greater in which operation would be

justifiable.   His ultimate conclusion that operation between attacks is to be advised if these are so frequent as to interfere with the enjoyment of life or prevent a living from being made seem to be a fair statement of the case.   After all the argument points not so much to the immediate operation as to the early, and while no rule may be absolutely laid down which will dispose of every case, it may be urged as safe to resolve doubts by exploration, and in the event of a recurrent attack seen for the first time, to anticipate the possible, or probable results of delay, without waiting for further recurrence.

ON THE RESECTION OF THE APPENDIX VERMIFORMIS DURING THE QUIESCENT STAGE OF CHRONIC RELAPSING APPENDICITIS[1]

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IN THE early part of last year I took occasion to remark, in speaking of intermediate laparotomy for appendicitis in its quiescent stage,[2] that it might be questioned whether sufficient data existed to warrant the use of so severe a recourse as this in these cases; or, in other words, that it should not then be considered as settled that surgery is justified in its interference by the removal of appendices when the symptoms of surgery are not present. This opinion was based upon the consideration of some six cases that had been brought to my notice, which not only had a mortality of one case, but in four of which there were such slight changes in the appendix as to give rise to the idea that we were dealing with a lesion different from what was found in the acute processes and that in the example then under my consideration no serious trouble would probably have arisen in the future, even though an operation had not been performed; and in the remaining two of which the adhesions surrounding the appendix were of such an extensive character that the removal of the affected organ was practically impossible. It was then admitted, however, that

[1] Read at the meeting of the Medical Society of the State of New York, Albany, February, 1889.

[2] Remarks on Intermediate Laparotomy for Recurring Appendicitis in its Quiescent Stage.—Med. News, March 1, 1890.

when recurrent attacks of appendical inflammation were so frequent as to impair the patient's usefulness in life, it was proper to run the risk of a laparotomy for their relief. Though my feeling then and also until recently was, that even in these cases, it was wiser to delay operation until an acute attack was in progress.

Since that time experience has grown with great rapidity in this department of surgery. I have been able to collect some 26 cases; probably, not all that have been published, but they attain a sufficiently large number to enable me to draw deductions somewhat different from those that came into my mind a year ago.

Considering now in detail the 26 collected cases,[3] I have found there was but one death. The mortality of the operation, therefore, must be considered to be a slight one; and in all the cases that have recovered, the recovery has been a satisfactory one. That is to say, the patients have been relieved from their recurrent pains and have enjoyed thereafter a decidedly improved condition of health.

A second point of considerable importance is that two conditions of the appendix have been found in these operations, viz., the perforative form, or the ulcerative form about to perforate from the distension from retained fluids; this, however, is only reported in 2 instances out of the table of 26.

In no instance has there been present any concretion, or foreign body, such as is generally encountered in the acute perforative appendicitis.

In addition to this, there has been made known to us sundry conditions which are grouped under the head of chronic catarrhal appendicitis, meaning by this, in its simple form, that the walls of the appendix were thickened, with its mucous mem-

[3]Performed by Treves, Senn, Hoegh, Hadra, Greig Smith, Porter, Monks, Stimson, Murray, Lange, Bull, McBurney, Baldy, Teale, Wyeth, Holmes and Abbe. The operations of Tait, Kümmel, Bernardy, Baldy and two of my own, are omitted from the consideration of the question as they were resorted to too close to an acute attack to be properly included, or the appendix was removed in connection with another disabling lesion, as in two of Baldy's cases. One of Bull's also is not included for similar reasons. In this the adhesions were great, and the appendix was not found. In all the excluded cases recovery took place, thus confirming the safety of the operation—i.e., 35 cases in all with 1 death.

brane more or less changed, and its lumen either entirely obliter-
ated or diminished in size to that of a small cord. It will be
remembered that similar pathological conditions are met with
in autopsies on about every third person dying from other
causes. This condition of simple catarrhal appendicitis was
encountered in 10 instances in the 26 extirpations of
the appendix. In other instances, the appendix besides
presenting the above named conditions contained a
small amount of mucous, or muco-pus, or grumous, brown
fluid. This general catarrhal condition was associated in four
other cases with either a kinking or bending on itself of the
appendix, or with a stenosis of the appendix in its upper por-
tion conjoined with accumulations of the contents, pus or
muco-pus, beyond the portion narrowed by either of these just
named causes. In the 26 operations made for recurring ap-
pendicitis there were 4 cases where the removal of the ap-
pendix could not be accomplished and of the 22 removals
it was found that in 6 cases the appendix was free from
any adhesions whatever; in 6 other cases only very slight
adhesions were found, and in 6 further cases the adhesions
were very marked and extensive, making the operation tedi-
ous and more dangerous (Greig Smith). In 3 of these latter
cases the appendix could not be found. In the 4 remaining
cases no report of the condition of the appendix is given.

It would seem at the first view of these facts that the interior
conditions of the appendix which gave rise to the recurrent
pains and prevented the individual from carrying on his usual
vocations, and also demanded the operation, were such as would
not have imperilled his life in the future, or that if any abscess
occurred it would be a limited one by reason of the previous
adhesions (?), and that, therefore, the risk of the operation
was really greater than the risk of the disease. And this
brings up the question as to what is the *status quoad* life of
the chronic catarrhal forms of appendical inflammation.

The prophecy made in the *Lancet* in 1889, that the appendix
cæci would prove the battle ground of the struggle between the
advocates of the medical and surgical line of treatment in
typhilitis is being fully carried out, and particularly in this
special connection. The surgical treatment advocated for

several years past in the treatment of acute appendicitis has been unanimous in this one point, that it should be applied as early as possible in the disease. This dictum on the part of surgeons has been met by the opposing experience of physicians, that in the observation of the latter many cases get well by purely medical treatment alone. It has been difficult to reconcile these two views. It is true that by a surgical operation in the vast majority of the acute cases, a gangrenous or perforated appendix has been found as the cause of the abscess or of the general suppurative peritonitis encountered. Only rarely has a condition of an inflamed appendix, or an appendix that is distended, or that has been perforated by a collection of fluid, from within its walls, been met with. Individually, I have encountered out of eighteen removals of the appendix, but one instance of circumscribed abscess due to distensive perforation of the appendix, and in this the perforation is a minute one. Stimson has, however, recently presented at one of the sessions of the New York Surgical Society, two appendices from acute cases, wherein one, a catarrhal appendicitis existed, with a collection of fluid within it threatening rupture of its wall, and in the other, a general peritonitis ensued, without perforation of the inflamed appendix. These cases, though apparently rare, show that the catarrhal forms of appendicitis can bring about a severe peritonitis. Unfortunately, up to the present time there is no correct or reliable appreciation of the mortality of these catarrhal, or the so-called medical cases of appendicitis. Nor any method during life of positively differentially diagnosticating the same from the perforative lesions. The nearest approach to the solution of the former of these difficulties that one can obtain is that furnished recently by Fitz, who stated that he had seen in consultation during the past four years 72 cases of perityphlitis, of which 74% recovered, and 26% died. About half of these cases were treated surgically, and the other half medically. Of the surgically treated cases, 40% died, and of the medically treated cases 11% died. Of these medical cases, 14% subsequently resulted in spontaneous evacuation of the pus. He draws, as a result of this experience, a deduction, probably as nearly correct as one can now come to, although

it necessarily excludes those cases which demand in the present cases the most searching inquiry, to-wit: the mild cases of recurrence seen by the general practitioner, so mild, indeed, as not to require a professional consultation. It is this, that the recurrences, instead of, as given by him in previous statistics, being as low as 11 %, have risen as high as 44 %. His judgment, based as it has been upon large experience and careful study of this subject, is, therefore, that intermediate laparotomy should be performed when the patient is debarred, from this cause, from the enjoyment of life, or the ability to earn a living.

From the uncertainty of attaining a proper discrimination in diagnosis, and from the slight mortality in the quiescent stage of the disease, together with the uniform excellence of the results, I feel I must now fully concur in this judgment. The objection of the possibly resulting ventral hernia can best be obviated by special care in suturing the layers of the abdominal parietes, and by prolonged recumbency.

In only one case of the twenty four[4] was there an imperfect restoration of health. It can also be added that beside the three cases in which it was found impossible by reason of the extensive adhesions to remove the diseased organ, there is another (Treves) case where the freeing of the adherent appendix was alone resorted to, as this was seen to be sufficient to allow its contents to be discharged into the cæcum. In this and in one of the unremoved appendices a subsequent complete restoration to health was obtained.

The limited time allowed to the reading of these remarks will not permit any elaboration of certain important points connected with the subject of the natural history, so to speak, of the catarrhal form of appendicitis, as contrasted with the perforative or gangrenous form, but I venture to sum up my ideas, yet vague in part, in a few statements which are here briefly submitted:

1. That the final outcome of the review of these cases has been that the large majority of recurrent attacks are due to catarrhal appendicitis, which, though to an unknown degree capable of producing explosive and serious peritoneal

[4] The two recent operations of Drs. Bull and Abbe must here be withdrawn.

inflammation, yet, generally, from the lumen of the tube being previously shut off from the cæcum, limit correspondingly the chances of fæcal or severe infection of the peritoneum.

2. That the simple catarrhal appendicitis can be suspected when the recurrences are frequent, that is to say, more than four or five times, as in the acute processes[5] this is seldom exceeded, and when such attacks are not of a severe type, nor of greater duration than a week, and particularly so if there be no appearance of a distinct tumor.[6]

3. In such cases delay in operating may be encouraged to a reasonable extent, at least until it is indubitably proven that the invalidism is a confirmed one. Out of five cases seen by me in the last year for recurrent attacks of appendicitis, in three of the above-described simple form, it was advised to wait till the next acute attack presented itself as a further justification of surgical interference, but this did not occur in any of these. In the two others, from the persistent invalidism, or the severity of some of the attacks, an operation was advised.

4. Where a tumor is present in the quiescent stage, or has been decidedly felt after the acuteness of the attack has passed off, more urgency is present, as it indicates, it is believed, either an accumulation of noxious contents, or of ulceration within the appendix, or an already present small perforation. It is in such cases that Mackenzie says that we can expect, if an acute process is subsequently set up, that it will be of the circumscribed rather than a general suppurative peritonitis. The frequent conjunction, in the collected cases, of adhesions with the severer forms of the catarrhal appendicitis, with retained secretions, or with minute perforations, seem to corroborate this view.

5. That as the diagnosis of the separate condition of sim-

[5]In the examination of 30 cases of acute perforative appendicitis where recurrence was noticed, I found that the explosion into abscess, or general peritonitis, in 22 instances occurred before the third attack, and only once did it occur after fifth attack.

[6]The detection of a tumor in an acute attack is often very difficult; mere dulness on percussion is not always reliable.

ple catarrhal appendicitis and its complications of distension
from retained fluids, and of ulceration, are not to be at present
differentially diagnosticated, and as it has been shown that
each can give rise to dangerous conditions, recurrences of se-
verity and frequency should hereafter mean that an explora-
tory laparotomy should be resorted to, on the general princi-
ple of this being of less risk than the disease itself.

INSTANCES OF FOREIGN BODIES LODGED IN THE BODY.

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I.—A Tooth in a Bronchus Produces a Pulmonary Abscess. It is Expelled Spontaneously and the Patient Recovers.

A MIDDLE-AGED man presented all the symptoms of a copiously suppurating cavity in the apex of the right lung, and was supposed to be afflicted with consumption, After I had attended him for three months, during which he improved greatly, he expelled a tooth from the lung during a severe paroxysm of coughing. Recovery from all symptoms of pulmonary disease was rapid and complete.

A minute cross-examination now showed for the first time that, one year previously, the man had, as he supposed, swallowed a tooth immediately after its extraction, and that his illness had dated from that time.

II.—A Piece of Sheep's Vertebra in the Lung Produces an Abscess Which, After One Year, Results in Death.

A woman, æt. 50, while hastily swallowing some soup, felt that a hard substance had passed into the air passages. An immense cavity rapidly developed in the lower lobe of the right lung. After six months, during a severe paroxysm of coughing, a large piece of the body of a sheep's vertebra, the shape of a maltese cross (measuring 1 by $^1/_2$ by $^1/_4$ inch) was expelled. The cavity, however, continued to suppurate and the woman died about a year after the date of the accident. Prof. S. D. Gross examined this case but did not suggest any operative procedure.

III.—A Bean in the Air Passages Causes Speedy Death.

A boy, æt, 5, while holding some beans in his mouth, suddenly exclaimed that one had "gone down the wrong way." Suffocative symptoms were at once noted and continued until death 36 hours afterward. Physical examination showed that no air entered the right lung. The parents would not permit an operation.

REMARKS.

Since the days of the "new surgery," nobody will dispute that these cases should have been treated after carefully locating the intruding substance by physical examination, and making a low tracheotomy, by if possible, finding the foreign bodies with probes and extracting with forceps.

W. D. Cheadle and Thomas Smith of London record a case in which a metal cap from the end of a pencil was extracted from the extreme end of the left bronchus. The location of the object was determined by physical examination before operation. The patient completely recovered. *Lancet*, Jan. 14, 1888. ANNALS OF SURGERY, Vol. V., p. 136.

Before resorting to forceps, I would try in a suitable case the effect of a plan successfully employed by a patient of Dr. Robert Cheesman. (*Medical Record*, March 16, 1890).

While a child, æt. 3, was suffering from a violent paroxysm of coughing, the father, with a vague idea of aiding the child in what appeared to be efforts to expel something from the lungs, suspended him by the legs, at the same time slapping the back rather vigorously. Upon putting him down the child appeared to be struggling with something in his throat, and the father, inserting his finger, extracted a nail which was covered with a thick coating of iron-rust and mucus. Pus continued to be expectorated, and the child finally died.

If operation be deferred until localized suppuration has occurred, pneumotomy is indicated.

The possibility that the surgeon may find the pleural surfaces non-adherent over the abscess, has undoubtedly prevented many operations for lung abscess. What should be done to meet this difficulty? The followig methods readily suggest themselves:

Having resected a portion of one or more ribs, a minute opening might be made into the pleural cavity (working if thought best through a layer of sterilized water) and part of a strip of gauze pushed in; after a few days the gauze could be removed and the operation finished. Or, instead of the gauze a few drops of tincture of iodine might be injected; or, possibly, the two surfaces could be stitched together, or adhesion be secured by gradually burning through the parts over the pus cavity with the thermo-cautery, making the sittings at intervals of two or three days.

IV.—Removal of the Tip of a Hard Rubber Sound From the Pregnant Uterus

A healthy woman, two months pregnant, while inserting a hard rubber sound into the uterus, broke off a piece two inches long, which remained in the organ. Dr. E. A. Follansbee was consulted, and asked me to assist in the management of the case. With the metallic sound the body could readily be felt, but as it lay across the uterus, and its ends seemed to be embedded in the mucosa, it could not be removed until the cervix was dilated, which was at once accomplished by Goodell's dilator, under ether narcosis. The body was now readily removed by a slender pedicle forceps guided by the finger. As the membranes had been ruptured by the patient's probing, the uterus was emptied by the finger, and washed out. Afebrile recovery.

V.—A Glass Disc Remains in the Vagina for Ten Years Causing a Stricture, Which Requires to be Incised that the Disc May be Removed.

A woman, æt. 60, had worn a glass disc in the vagina continously, for the relief of prolapsus, for ten years. As it finally produced a purulent discharge she asked me to remove it. One and a half inch up the vagina a stricture barely admitting the index tip was felt. It was incised in the median line posteriorly and a disc two inches in diameter removed. Unfortunately hæmostasis was carelessly made, and the patient bled for two days before she thought it worth her while to send for me. It took two months to cure the resulting anæmia. After six months the patient reported that she was well and that the prolapsus had not recurred.

VI.—A Child is Treated for Nasal Catarrh for Four Years, and Recovers on the Removal of a Shoe Button From the Nose.

A girl, æt. 8, had received much unavailing treatment for the relief of a profuse purulent discharge from the right nostril. On inserting a probe I distinctly felt a smooth hard body buried in a mass of rotten tissue between the inferior and middle turbinated bones about one inch behind the tip of the nose. The body, which was supposed to be dead bone, was easily removed, and proved to be an ordinary gaiter button. Recovery was rapid and complete.

VII.—A Threaded Needle is Removed from the Calf of the Leg, After a (Probable) Sojourn of Many Years.

A lady, æt. 20, presented a small hard, tender swelling on the right calf. Incision revealed a pointless, blackened sewing needle. Attached to it was a piece of rotten cotton thread, which was with some difficulty drawn from the muscle in which it was imbedded apparently stretched out at full length. No pus was present. Neither the patient nor her mother could explain how the needle got there.

Suspension by the heels should prove beneficial in many cases in which it is generally neglected. In a case of intubation of the larynx in which I was on the point of removing the tube, it slipped from the extractor and the child began to choke. The father was immediately ordered to suspend him by the heels when a few slaps on the back expelled the tube.

The same position combined with enormous enemata enabled me, nineteen years since, to save the life of a child almost dead from intestinal intussusception.

Some twenty years since a writer in the *American Journal of the Medical Sciences* strongly advocated a similar position in the treatment of strangulated hernia. Fired with enthusiasm, at this suggestion, Dr. A. K. Minich of Philadelphia and myself, shortly after the appearance of the article, essayed a trial of it on a patient whom we supposed to be suffering from a strangulated, inguinal hernia. It was August, and the man weighed 175 pounds; we labored long and faithfully but could not reduce the swelling. Completely puzzled, we called on Dr. Frank Mau y for assistance. He had the temerity to differ from us in diagnosis and what was worse proved he was right by operating and revealing a hydrocele of the cord.

REPORT OF THREE CASES OF FRACTURES WITH FATAL TERMINATION.

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CASE I.—FRACTURE OF THE BASE OF THE SKULL; MULTIPLE FRACTURE OF RIBS; FRACTURE OF ACETABULUM; FRACTURE OF HEAD OF FEMUR.

I WAS called, March 20, 1889, to attend a ship carpenter, æt. 53, who had fallen 30 feet from the mast of a vessel into the hold, thereby sustaining certain injuries which, a few days later, made his remains an interesting dead-house study. Twenty minutes after the fall his pulse was 70 and regular, respiration 16 and full; pupils normal in their dimensions and their reactions to light; he was unconscious; there was hæmorrhage from the right ear, but no evidence that cerebral fluid had escaped. There was a lacerated and contused wound over the left parietal eminence, a dorsal dislocation of the femur and fracture of eight ribs—the point of fracture uniformly three inches from the vertebral column. Reduction of the femur was delayed until the patient had partially rallied from the profound shock. While manipulating the femur, crepitus could be felt when certani movements were executed. No diagnostic symptoms of the fracture of the neck were apparent.

The femur was reduced without much difficulty. At the expiration of 24 hours symptoms of cerebral compression developed. The trephine was applied an inch beneath the point of external injury, and several blood clots of considerable size were removed. By a small incision in the dura mater, considerable fluid escaped. Following the operation there was marked improvement; for the first time he was able to talk, made his wants known, and recognized his friends. Late on the third day he died. At the autopsy, a fracture of the base of

the skull, on the side opposite the external wound, was found. The line of fracture passed through the petrous portion of the temporal bone and through the sphenoid to the median line, passing through the auditory canal. Yet at no time was there appreciable evidence of the escape of cerebral fluid. The absence of this symptom should not bear as much weight in making a diagnosis as the literature in some quarters would lead us to do.

The line of fracture of the ribs was from within outward and forward. The pleura was extensively lacerated and the lung at one point punctured. The ribs when reduced would not so remain without support.

Fig. I.—Fracture of Brim of Acetabulum.

On exposure of the hip joint the acetabular fracture was found to be one half inch in altitude, with a base one-half the circumference of the acetabular brim. The head of the femur was fractured. The fragment corresponded with that part of the head intercepted by a plane passing through it at the junction of the neck, including about one-third of the area of the head. The capsule was extensively lacerated. The soft parts, for a considerable distance outlying the joint, were densely infiltrated with blood and serum.

The segment of the head separated by the fracture was attached to the neck by a small ligamentous band. (See Fig. II.)

The fragment was lying outside the acetabular cavity and hugging

the bone.   There was no evidence of previous disease of the hip-joint, the femur or the pelvis.   The position of the bones indicated that the blow was received over the trochanter major, the head having engaged

FIG. II.—FRACTURE OF HEAD OF FEMUR.

itself against the side of the acetabulum, thus simultaneously fracturing the deep portion of the head, and the remainder carrying away the brim.

CASE II.—INTRACAPSULAR FRACTURE OF THE NECK OF THE FEMUR; LONGITUDINAL FRACTURE OF TROCHANTER MAJOR WITH OSTEOPHYTES.

A German, æt. 48, in fair general health, had served in the late war. While pruning a tree, he fell eight feet, alighting on some flagging. He felt considerably hurt, but walked to his home near by.   Household remedies were applied to relieve what was considered to be a bruise. The discomfort and pain persisted, and the family physician was called the following day.   The physician found only a bruise.   There was no shortening, no crepitus, no deformity, and only modification of function.   Three examinations were made during the first two weeks; at no time was a fracture apparent.   On the fifteenth day the patient felt something "give away" in the hip joint.

A consultation was held, and the symptoms of a fracture of the neck were pronounced   There were shortening, eversion and crepitus. He was immediately placed under treatment appropriate for such fracture. In a short time his health began to fail.   Albumen was found in the urine in increasing quantity.   The patient had never previously consulted a physician for any renal disease. He had had, however, a "kid-

ney trouble" some years before. The patient gradually lost ground and died at the end of 74 days.

By courtesy of the attending physician, I was permitted to make an autopsy. The limb was found four inches shortened and markedly everted. Just below and external to Poupart's ligament, there was a large bony protuberance, which was movable, and about the size of two fists. Hard nodular masses could be easily felt in the region of the trochanter major and the gluteus. These were masses of bony formation—osteophytes—which surrounded and skirted the entire region of bone injury. Their base was near the bone, but easily dissected out. There was a transverse intracapsular fracture of the neck, midway between the head and the trochanter; also a longitudinal fracture of the trochanter major, extending into the shaft of the femur. Scales or plates of bone corresponding to the attachment of muscles along the superior curved line of the ilium were detached and dragged down an inch or more. This condition obtained to such an extent that the superficial muscles were loose and flabby. Some of these pieces were equal in area to a silver half dollar. Although 74 days had elapsed there was no apparent effort at repair; the ends of the fragments were as smooth as if polished There was no callus.

The head of the femur was not altered in contour or in size, with no evidence of any antecedent disease of the bones entering into the formation of the hip joint. The hard bony growth had obeyed no formative law. Some were found between layers of the muscles.

CASE III.—FRACTURE OF SURGICAL NECK OF THE HUMERUS; MINIMUM TREATMENT; DEATH FROM PNEUMONIA AFTER TWENTY DAYS; ABUNDANT AND FIRM CALLUS.

This case presents some points of marked contrast to the one just described.

A German woman, who, for many years, had been in feeble health, had had repeated attacks of pneumonia, and for many years suffered from chronic bronchitis and asthma; and would, at frequent intervals, fall in a fainting spell.

In one of these attacks she fell down stairs, thereby sustaining a fracture of the surgical neck of the humerus. The injured arm was lashed to her side, while the profound shock which ensued was combatted. She rallied slowly. In spite of stimulation and frequent change of position, pneumonia developed in a few days. The fracture received no further attention than the lashing of the arm to the side.

Her general condition was bad.   In twenty days she died.   The autopsy was interesting, inasmuch as the treatment of the fracture was a secondary consideration.   The fragments of bone were in excellent apposition, the line of the fracture oblique.   An abundance of callus had been formed, definitive and ensheathing.   The union was firm enough to resist considerable bending.   During the last few days of her sickness, she was delirious and tossed about in her bed, disregarding the broken arm.

Splints in this case would have been worse than useless.   However, the unfortunate complication, causing muscular weakness, prevented the tendency to displacement by muscular contraction.

In the first case we find a rare form of fracture of the head of the femur, complicating a dislocation—a form not mentioned in the standard works on fractures or dislocations. Opportunities for autopsies in cases of dislocations being limited, it is probable that this complication may explain the results in some cases, which can scarcely be accounted for on other grounds.

In the second case we have a marked instance of the support of the capsule to the fragments of an intracapsular fracture, the patient being able to get about by the aid of a cane for 15 days, then the capsule, weakened by stretching and perverted nutrition, suddenly gives away, and marked shortening and loss of function immediately ensued.

The absence of any evidence of repair of the bone within the capsule is not unusual, but the same condition of the fracture of the trochanter may fairly be attributed to the renal lesion.   Unfortunately the autopsy was not permitted to extend beyond an examination of the fracture.

In the third case, taking into consideration the age, the feeble health, the complication and the limited treatment, and the fatal termination in 30 days, so good union and coaptation was scarcely to be expected.

These cases emphasize the importance of a careful prognosis.

It is the purpose of this paper simply to present a few points that may be of interest, realizing that the number is too small to draw conclusions.

THE MÜTTER LECTURES ON SELECTED TOPICS IN SURGICAL PATHOLOGY.

SERIES OF 1890-1.[1]

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LECTURE III.

PYOGENIC ORGANISMS.

SYLLABUS. *Pyogenic Organisms.*—Obligate and facultative. Staphylococci; consideration of their varieties and common characteristics.

Streptococci.—Identity of those of pus with those of erysipelas. Comparison of the general characteristics of the two genera and of their peculiar activities. Distinction between erysipelas and allied, yet clinically different forms of cellulitis, etc.

Bacillus pyocyaneus.—B. pyogenes fœtidus, etc.

Gonococci.—Included here, though not properly belonging here, since it is doubtful if they are truly pyogenic. Their relations to pus and to purulent mixed infection.

Pneumococci and Other Forms.—Bacilli tuberculosis, typhoid bacilli and other organisms rarely met with in pus. Table giving author's statistics of personal work.

A FEW years ago the known pyogenic organisms, or those which have the power of provoking the formation of pus by the destruction of exudate, could be counted on one's fingers. But the list now is greatly extended, and the organisms now known to be pyogenic belong to more than one genus,—belong not even in one kingdom, since they include both animal and vegetable forms. The former, however, pertain mainly to the lower animals, and man's worst enemies are principally bacteria.

[1]Delivered before the College of Physicians, Philadelphia, December, 1890.

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While then it would appear to be impossible to give in exact detail the name or biological position of every organism that has the power of producing pus, those subjoined below are by all means the more common forms met with in it. There is every reason to believe that there is not one of the pathogenic microbes which may not have the power, at particular times or under peculiar circumstances, of producing pus, yet there are a limited number of forms which are so invariably met with in it and which so uniformly have the power of producing it if they exert any action at all, that they are grouped in an arbitary class under the name of pyogenic organisms. They are, of course, distinguished from each other, as are all other micro-organisms, by their microscopic appearance, peculiarities of growth, and their effects on animals. It has already been known for many years that organisms which, to the naked eye, in cultures, as well as when examined under the microscope, have every resemblance and appear to be identical, are yet capable of producing different effects in the living tissues. Possibly when our powers of observation shall be still further aided by some new device we may recognize some differences between them that at present we are unable to appreciate. For purposes of illustration, I have often put it in this way to students, that when we are at a distance from a crowd of human beings they all look alike to us, but that as we approach nearer we begin to notice differences of apparel and then of feature, so that we recognize friends or pick out strangers. So also one might tell the difference between two armies by the general color of their uniforms; and yet not be able to identify any particular organization. So it is in examining bacteria. Under the microscope alone all the pyogenic staphylococci appear alike. If we could get nearer to them, as it were, we might be able to distinguish between them. So, too, when we view an immense number of them on the surface of a nutrient jelly, we are able to distinguish one form from another by means of the particular color which they produce. The color of a culture by itself tells us no more about its distinctive organisms than does the color of an army seen at a distance, tell us what particular soldiers are engaged. We have certainly accomplished a great deal in the separation and

identification of individual organisms, the final and crucial experiments in most instances being upon animals.

The wholly arbitrary yet clinically justifiable classification of *pyogenic* organisms would be into the *obligate*, that is those which always produce pus if they are given time and have any effect at all, and the *facultative*, which apparently only at times cause suppuration.

The Obligate.

1. *Staphylococcus pyogenes aureus.*—The staphylococci are so called because they tend to arrange themselves in the form of clusters. They grow easily at ordinary summer heat, but most rapidly above 3c° C. When grown in gelatine this variety causes liquefaction with the development of an orange-colored precipitate. Grown upon agar there appears within twenty hours a whitish or light yellow opaque tint which soon becomes more distinct, and of a bright orange. It presents the same appearance upon potatoes.

2. *Staphylococcus pyogenes albus.*—This organism is very similar to the previous one in the character of its growth, and in its effect on animals, but it produces no pigment. Observers differ in opinion as to whether it is more or less virulent than the aureus.

3. *Staphylococcus pyogenes citreus.*—This grows like the former, liquefies gelatine, and produces a growth at body temperature which presents a light yellow color, indistinguishable at first from cultivations of aureus, declaring itself some days later. In each case this pigment occurs only on exposure to air. Where it grows along the needle streak, in agar, there is no color reaction. The pathogenic properties of this variety are probably milder than those of the two before mentioned, though all three are pathogenic; by which term it is meant that the results of injections or experiments in animals is death. An organism which when injected into an animal makes it sick only and does not kill it, is not considered by bacteriologists as pathogenic. It behaves in most respects like the aureus and albus. When cultivations upon solid media are covered with a layer of oil, Passet found that their bright lemon yellow color was not produced.

An exact estimate of the relative powers of these three forms can hardly yet be made. It has also been claimed that the aureus after transmission through the bodies of several animals becomes changed into the albus, but I do not think that this claim has ever been substantiated, while the distinction between the aureus and the citreus seems sufficiently well established. There is every reason to think, from clinical experience, that the virulence of the same species differs within wide limits at different times, since results are gotten with them at one time by one observer which cannot be repeated by others. This seems to be especially true of acute infectious osteomyelitis. A special staphylococcus of osteomyelitis has been described by some writers, but the opinions of those best fitted to express them concur in the belief that it is really identical with the staphylococcus aureus, differing only in this unknown characteristic of virulence. This group has been studied chemically as well as biologically. Passet made some investigations into the chemical activities of these three pyogenic varieties. He found that the gelatine which they fluidify has a neutral, not an acid reaction. This is probably a transformation of gelatine into gelatine-peptone. According to Brieger these forms give off ammonia, while the streptococci produce trimethylamin. All of the cocci which Passet found in abscesses, as well as pure pneumococci and the cocci of erysipelas, cause a curdling of milk.

4 and 5. *Staphylococcus cereus albus* and *flavus* are the names of two varieties identified by Passet. Each grows with a wax-like layer on the surface of gelatine, and in patches on potatoes. In the one case this layer is white, in the other of citron-yellow color. These two forms are met with occasionally in pus from the human subject, although I believe never alone. They are not pathogenic in rabbits, and in many other animals, and are not supposed to be in man. The surface of their growths has a particularly waxy sheen, while along the needle track they both form a grayish white streak with fine beads.

6. Babes has described and named the *staphylococcus flavescens*, which probably occupies an intermediate position between the aureus and albus. It liquefies gelatine, and its

growth on agar becomes yellow after about eight days. It is pathogenic for mice.

7. *Staphylococcus pyosepticus.*—Richet has described a microbe which he found in a cancer in a dog, and which he named pyosepticus. It is distinguished from the albus by its effects on animals. It both produces pus and fatal general infection. It has a short life, and grows best at 38° C. Below 25° fluidification of gelatine does not occur until the seventh day; this is later than occurs with the albus. Also in beef-tea cultures there are recognized differences. In rabbits it produces great œdema within twenty four hours, while the albus produces only the slightest infiltration. Later fever, emaciation and death result. Inoculation in the anterior chamber causes rapid suppuration and destruction of the eye. Death seems to be produced by a ptomaine, and in most rapid cases within from ten to forty eight hours. In dogs injections are followed by phlegmon, and high fever. Evidently it is much less virulent in dogs than in rabbits. Guinea pigs and doves succumb quickly. By vaccination with reduced cultures, animals are given an immunity from the virulent material. In the blood it seems to perish quickly   In chronic cases it is found in colonies, especially in the liver. Experience with this organism in man has not been reported. (*Archiv. de Med. Exp.*, 1889, No. 5.)

Another peculiarity common at least to the pyogenic staphylococci is their wonderful vitality. They have the power of lying dormant in the tissues for months and years, and then of being aroused into activity by causes unknown, but such as accompany acute febrile or wasting diseases. Even in cultures they remain active for a long time. Old cultures emit a well-marked odor much like that of starch paste, and this odor can be frequently recognized in old dressings which have been saturated with pus. They more easily enter the blood current, and are by it more quickly disseminated. Phlegmons caused by staphylococci pursue a more rapid course both in time and in intensity of disturbance. There is no doubt at all in my mind but that collections of these organisms may hibernate, so to speak, in the bones, and possibly in other tissues, for twenty years, and then become again active, and exert sometimes a fatal degree of virulence.

According to all observers, the organisms which are most frequently met with in pus are the staphylococci, and of these most frequently the aureus, with the albus next. These are associated with acute abscesses, boils, acute osteomyelitis, etc., and their combination seems to be particularly unfavorable. Streptococci are also frequently present, but they are especially associated with erysipelas, or erysipelatoid processes, where suppuration occurs rather in the form of purulent infiltration, than from circumscribed abscess. They occur also, as was first pointed out by Ogston, in progressive gangrene, and are the chief or the most deadly organisms in pyæmia. Mastitis in women offers a good example of the different mode of action of these two species. Those mammary abcesses which are caused by staphylococci begin in the deeper part of the organ, and spread towards the surface, while suppurations which are caused by streptococci commence with an erysipelatoid affection of the skin, and extend from some crack or fissure of the nipple, the suppuration in the deeper part being secondary. The explanation is that the staphylococci act from the interior, spreading along the milk ducts, while the streptococci invade first the skin and spread along the lymphatic vessels. This statement is founded upon the demonstrations of Bumm, and is not theoretical.

Kitt has investigated similar disease in cows, and has cultivated a peculiar streptococcus from these cases, the injection of which sets up suppurative inflammation. In one case he injected pure cultivations into the milk ducts, with the result that in a few hours the corresponding portion of the udder became swollen, and by the next day it was acutely inflamed.

The clinical conclusions of Ogston, Rosenbach and Passet have been confirmed by Bumm and others, and may be stated about as follows: The staphylococci are the causative agents in primary and parenchymatous abscesses, while the streptococci are more disposed to excite peri-adenitis which shall terminate in abscesses. Bumm often found the former along with diverse non-pathogenic forms in fissures of the nipples, which do not accompany mastitis, and showed how they might thus penetrate even deeper and set up suppurative trouble. In at least one case he was able to demonstrate by sections, stained by Gram's method, that this had actually occured.

Okintchitz thinks that the staphylococci have a tendency to sectional localization about the joints especially in pyæmic cases, and that the streptococci manifest a predilection for cellular tissue. In this respect he takes a diametrically opposite position to Krantzfeld and Pawlowski. The staphylococci are so frequently found along with other pyogenic forms, that it is hard to assign them their exact role.

In 1886 Bonome described three cases of pulmonary tuberculosis in which he recognized staphylococci as the active agent in producing secondary suppuration, that is empyæma. In one case he recognized besides this form a diplococcus which he regarded as identical with Kleb's *micro sporon septicum*; so also in five cases of pulmonary gangrene he found them everywhere. On experimenting with pure cultures of the same germs made from these cases he succeeded in producing local gangrene at points of injection. He regards them as the active agents in causing the tissue necrosis, and holds the putrefactive features of these cases to be easily explained by the entrance of saprogenic organisms through the respiratory channels.

It has always been difficult, hitherto, to explain suppurative changes in the kidneys in scarlet and other eruptive fevers.

If we remember, however, that five years ago Fraenkel showed us how staphylococci were almost always to be found in the crypts of the tonsils, especially in cases of sore throat, it can readily be seen how they have ready access to the general circulation.

While, as we shall see shortly, there are differences of opinion as to the organisms most frequently concerned in producing pyæmia, and while the streptococci seem to be those especially to blame, we may as well mention here the results obtained by Pawlowski, who carefully examined five pyæmic cases. In one of these the metastatic manifestations were confined entirely to the joints. In this case he found streptococci alone. In the other cases he found staphylococcus aureus in the organs and soft tissues; results which tally well with those of Krantzfeld. One of his conclusions is worthy of repetition here: "These experiments lead me to the conviction that the staphylococcus pyogenes aureus is the active cause of pyæmia. For the development of the typical subacute form of pyæmia, there are required, indeed, beside the micro-organisms, decided disturbances of nutrition, such as fractures and general circulatory lesions."

Evidently a great variety of disturbance may be caused by the same organisms, this being due to causes some of which are still obscure. Thus, the staphylococcus aureus may cause a dermatitis, a boil, an abscess, acute ulcerative endocarditis, acute infectious osteomyelitis, or even pyæmia; while the streptococci cause sometimes erysipelas, and sometimes peritonitis, mastitis, puerperal fever, and even pyæmia also. Their varying action is not alone due to the numbers in which they are introduced, nor yet necessarily the locality where they are introduced. That they do not of themselves always set up abscess formation is evident from the fact that they are frequently present in the blood, while as yet no abscesses exist. They are even excreted in a living state by the kidneys without giving rise to secondary abscesses. In almost all cases of septic fever they may be found in the blood, and yet it is known that such cases frequently run their course without abscess formation. In acute osteomyelitis they are found in the blood, although there is no suppuration outside the bone.

Rosenbach has reported the case of a woman, æt. 30, married 10 years, with four children living, and healthy when born. Her fifth child, born at term, was, nevertheless, dead at time of birth, though apparently alive until shortly before that time. Attention was at once drawn to the right leg, which was swollen and showed fluctuation. The whole leg had an erysipelatous appearance, and much pus was evacuated. It was thought there had been necrosis of nearly all the soft parts of that leg, as well as of the bone. This is of interest as showing that the organisms which cause this acute gangrenous process must have been introduced through the blood of the mother.

A case occurring very recently under my own notice was that of a newly born child who rapidly developed an acute osteomyelitis of the right leg and thigh, as well as an extra capsular abscess about one shoulder, and who lived but a very short time after the disease declared itself. To be sure there was the possibility in this case that infection had proceeded from the umbilical cord, and yet there was absolutely nothing about the part to lead to the slightest suspicion.

Babes concludes that there is a difference between ordinary puerperal fever, which he considers a streptococcus invasion, and pyæmia following abortion, which he has found due to the staphylococcus pyogenes aureus. (*Prog. med. Roumain*, 1889, No. 24).

Escherich examined milk from nine healthy women without finding bacteria in it; also from five women suffering from non-puerperal fever, such as phthisis, syphilis, etc., and found no bacteria. In thirteen cases of puerperal fever once nothing was found in the milk, once bacilli were present, once other cocci were found only in the milk from one breast, while in ten the same organisms were present in the milk from both. In none of these was there any excoriation of the nipple, nor abscess in the glands. Staphylococci were the prevailing organisms He believed that in these cases the organisms entered the blood from the uterus and were excreted with the milk. Numerous other facts show that organisms may circulate in the blood without necessarily giving rise to local disturbances.

Garré's experiment to prove the active agency of staphylococcus aureus in producing phlegmons is now a matter of history. He inoculated a little wound at the border of the nail and in two days noted suppuration there. Then he rubbed into his arm, as if it were an ointment, a quantity of pure culture of the third generation, and in four days suffered from a typical carbuncle, with consecutive swelling of the lymph glands. Recovery was a matter of several weeks and of numerous scars. (*Fortschritte d. Med.*, 1885, No. 6.)

One such experiment, by the way, on man, is of more value than many negative results on dogs, which only go to prove their immunity, or at all events, their high resistence.

Aside from Garré's personal case of abscess following inunction we have Bockhardt's experiment upon himself. He introduced a minute portion of cultures of aureus and albus into the skin of one of his fingers. In forty-eight hours a small abscess had formed, and was opened, and from its pus he recovered the aureus. On another occasion he inoculated by inunction a portion of the skin of his forearm, about the size of a silver dollar. After having cleaned and disinfected it, and slightly irritated it with his finger nail, he employed the same mixture as before. Six hours after rubbing it in, the skin was reddened and painful; eight hours later a number of pustules had formed; these pustules contained the cocci which he had employed, and within a week they had dried up and disappeared. Some days later he repeated the experiment by rubbing in a cultivation mixed with a sterilized salt solution. Twelve hours later thirty-five pustules had formed; within five hours more he saw twenty-five more form, most of them being perforated by hairs. After a week all had dried up except two, which developed into large and painful boils, and for two or three months after he was subject to a recurrence of pustules upon the skin of the same forearm. The fact that Bockhardt's results were milder than Garré's was due to the fact that the former employed a much more dilute culture.

These pustules were of an impetiginous character, not being preceded by nodules or vesicles. These are such as Wilson defined impetigo to consist of, and may occur anywhere except where there is much hair. In such situations Bockhardt hinks that if the same cause acts sycosis will result.

In Wilson's impetigo he has always found streptococci, and he holds that the impetigo pustule is often a forerunner of a boil, for it is often seated on and precedes it. His views are corroborated by Zuckermann's investigations.

Bumm injected pure cultures of staphylococcus aureus into the subcutaneous tissues of his own arm, and the arms of two other persons. The cultures were mixed

with a few drops of salt solution before injection. On each occasion a large abscess developed, whose pus contained large numbers of the same organism.

Schimmelbusch has demonstrated very beautifully how bacteria may work their way along the hairs into hair folicles and there cause furuncles. He rubbed into the unbroken skin (like Garré and Bockhardt) pure cultures of staphylococcus pyogenes aureus, by which pustules were produced. The skin was then excised, hardened in alcohol, its fat dissolved out with ether, then imbedded in celloidin, and sections made in series, which were stained by Gram's method and then with some contrast stain. A careful microscopical examination then showed that there was not the slightest injury to the tissues, but that the organisms had followed the hair shaft down into its follicle, and there proliferated, and that the infection of the tissues proceeded therefrom.

He found the same true of furuncles of spontaneous origin. The sweat glands do not have the same liability, since on the palm and the sole, where they most abound furuncles are most rare. On the contrary he finds them most common at spots where friction of dirty clothing or of ordinary soil is most marked; thus the back of the hands, the neck, the belly (from belts), etc. (*Archiv. f. Ohrenheilk.*, xxvii, 1889, 4, 252.)

8. *Streptococcus pyogenes—seu erysipelatis.*—By the term streptococci are meant those which arrange themselves in chains, sometimes of considerable length. They grow slowly on the ordinary culture media at a summer temperature, but at greater rapidity in beef tea and at body temperature.

On gelatine they form small, round, colorless colonies, which spread scarcely, if at all, on the surface. On agar they grow in small points but very slowly, and when sown on agar along a needle streak the growth is found, after weeks, to have extended but a very trifling distance. They do not liquefy gelatine, but in the absence of oxygen exert an energetic peptonizing action. When first described we heard considerable about two forms, namely: the streptococcus pyogenes, and the streptococcus erysipelatis. It is the latter which was so carefully and beautifully studied by Fehleisen, and demonstrated to be the active agent in the production of erysipelas. Observers are now pretty generally agreed that these two forms are identical. Individual cocci in any of these chains, of whatever species, are not necessarily of the same size. We have here another illustration of the fact already alluded to that the streptococci, which are so pathogenic in men, have very much less virulent properties in the lower animals. Fehleisen's coccus will not kill mice, rabbits nor guinea pigs. Moreover, it does not grow on the blood serum of calves,

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hogs nor guinea pigs, but only on the serum of rabbits among these smaller animals. Nor does it grow in the bodies of these animals. It must be said, however, that the attempt from these facts to formulate a general rule that cocci grow only in the bodies of animals on whose serum they thrive, would not be justifiable.

In the present connection we are speaking of the one form to which the two different names have been given. Although from eight to ten different sub-species of streptococci have been carefully studied, all of which grow alike and look alike, yet they possess widely different pathogenic properties. Thus the streptococcus which by some is alleged as the cause of diphtheria looks and grows like all the rest which have no such power. Thus too, Behring has identified a sub-variety which he calls the streptococcus *murisepticus*, because it kills white mice in from forty-eight to sixty hours. This, too, was isolated from diphtheritic membrane, and, except by experiment on animals, can not be differentiated from other forms. In beef tea they all grow precisely alike.

The view that Fehleisen's erysipelas coccus is entitled to rank as a true pyogenic coccus is confirmed by Hoffa, who found it in the pus from a knee-joint whose overlying skin presented an erysipelatous inflammation. According to this view it is not necessarily nor invariably pyogenic, but may act in this way. De Simone also has reported the case of true pyæmia following an unmistakable erysipelas, in whose metastatic abscesses a small coccus was found, which tends to corroborate the same view. He also lays stress on the many remissions of temperature met with in cases of pyæmia, as well as erysipelas, in connection with the fact that the streptococcus erysipelatis grows to best advantage at temperatures below 37°C., and that at 41°C., after forty-eight hours, in cultures, it dies. According to this view the high temperatures noted at times in clinical cases may be a conservative or eliminative factor.

Hajek, differing from Baumgarten and others, considers the streptococcus of erysipelas and phlegmon not to be identical, although they cannot be distinguished by culture differences, since he says the principles of growth in the living body are not the same. He studied two cases of erysipelas, which were complicated with in-

tra-thoracic lesions. In one there was a sero-fibrinous pleuritic exudate in which he found a streptococcus having all the peculiarities of Fehleisen's. The other was a fatal case of so-called erysipelas-pneumonia, *i. e.*, pneumonia following erysipelas. In this case he found only Fraenkel's pneumonia-coccus. Fraenkel himself has quite recently made a careful study of the points of similarity between the streptococcus pyogenes or phlegmone, and that of erysipelas. He finds that neither morphologically nor in cultures, nor by color-reaction, can they be truly distinguished. He found the most beautiful growths in bouillon cultures. They behave alike in coagulating milk, and upon glycerine agar they grow alike. In experimenting upon animals no real distinction can be made, at one time phlegmon, at another lymphangitis, *i. e*, erysipelas being ca led out. In thus recognizing their virtual identity, he simply fortifies the position already taken by Bionde, Eiselsberg, Kurth, Winkel and others above quoted, and especially that occupied by Baumgarten in his large work.

Passet's studies concerning the retention of life of all these pyogenic cocci so far mentioned, agree very well with Rosenbach's, and are in accord with general experience. In jelly staphylococci will live a year or so, while streptococci do not last more than three months. Drying either of them on glass for ten days does not destroy their vitality. Even a heat of 99° C. for fifteen minutes does not certainly kill them.

The experiments of Schuetz in connection with the disease in horses known as strangles are significant. The disease occurs under two forms; it begins as a nasal catarrh, and in the milder form is followed by suppuration of the cervical and submaxillary glands, and ot those around the pharynx. In the severe form metastatic abscesses occur throughout the body, and the animal dies of a form of pyæmia. On examining the pus from these abscesses Schuetz found a peculiar streptococcus constantly present. These he cultivated on horse-blood serum, and was able to reproduce the disease by injecting a ure culture into the nasal cavity. These organisms are also pathogenic for mice.

Aside from the streptococci above mentioned, Hueppe separated and cultivated still another form, which he met with in a case of puerperal fever. This organism formed typical arthro-spores, similar to those of leuconostoc, and did not grow in nutrient jelly, but did grow well on blood serum. It will thus be seen to have been specifically different from the ordinary streptococci. It hardly seems necessary to rehearse at this point or in this place, all the varieties of pyogenic streptococci. Enough has been said to show that they at least have many common properties, and that as yet we have really no accurate way of distinguishing between them.

In general it may be said of them that they possess even more virulent properties than the staphylococci, and, indeed, their presence in large numbers is in some degree an index of the violence and acuteness of the case. If it were permissible to argue by analogy of biological form and properties, a marked illustration of the severity of disease, called out by

cocci which to a large extent resemble each other, might be found in such diseases of animals, as chicken-cholera, hog-cholera or swine-plague, rabbit septicæmia and, perhaps, some others. It is uncertain as yet whether these diseases can be inoculated at all upon man. They are at all events certainly acute and infectious enough in the animals mentioned.

GENERAL REMARKS UPON THE PYOGENIC COCCI.

Staphylococci and streptococci produce a peptonizing ferment by which albumen, even when coagulated, may be dissolved; and it is by virtue of this property that we have many of the phenomena attending suppuration. In milk they rapidly produce lactic acid, and this same lactic fermentation takes place sometimes in wounds, causing acidity of discharges, and in abscesses causes the well-known watery pus. (Cheyne). In our list of ptomaines produced solely in pure cultures of known species, we find none ascribed to pyogenic cocci; and they are not yet known to produce them; consequently fever attending suppuration can hardly be ascribed to this source. But, as Baumgarten suggests, it may be due to increased tissue change, due to their growth, the products thus formed being, perhaps, pyretic. Baumgarten supports this hypothesis by adducing the fever which occurs in trichinosis, where the question of ptomaines has not yet been raised.

Fehleisen is further of the opinion (*Arbeiten a. d. Chirurg. klin. Univ. Berlin*, III, 1887,) that the pyogenic cocci are not so much parasites in an actual sense, like anthrax bacilli, as agents for transportation of some injurious sub tances. He would explain the varying degrees of intensity of progressive sui puration and sepsis production rather by variation in strength or amount of the toxic material which they carry. In this matter he is decidedly opposed by those who believe these differences are to be explained rather by specific difference in activity which these organisms seem at different times to manifest. This latter view is borne out by analogy, since we see anthrax and tubercle bacilli evincing wide variations in specific energy under varying circumstances.

Okintchitz has carefully studied a number of cases of septic infection and pyæmia. (*St. Petersburg. Inaug. Dissert.;* Abstract in *Manchester Med. Chron.*) In his cases of so-called septicæmia he has failed to make the distinction between sapræmia and septicæmia which I shall endeavor to show is a legitim te and an important one, though he admits they deserve different names. In his cases of septic poisoning (*i. e.,* sapræmia) the patients' blood did not contain any pus microbes, though they were easily detected about the primary foci. But he did find in the

blood of one of his septicæmic cases a peculiar microbe, which he considers identi-
cal with Bardoni-Uffreduzzi's *proteus hominis capsulatus;* in another he found
Fraenkel's diplococcus and the staphylococcus pyogenes albus. In a number of
cases of phlegmon he found one or other staphylococcus form (in a few of them in
the blood), though only by culture experiments and not with the microscope. He
shows, however, that their appearance in the blood seemingly has little connection
with the intensity of fever or oscillations of temperature, and that the most pronounced
clinical difference between the mycotic and the non-mycotic changes consists ap-
parently in gastric disturbances, which are present in the former (mycotic) variety.

His pyæmic cases showed invariably either staphylococci or streptococci in the
blood, which could ordinarily be recognized even with the microscope. Organisms
thus found in the blood showed fission or reproduction very rarely as compared
with those found in the pus of the primary foci, hence the supposition is justifiable
that their reproductive activity is mainly confined to pus and not blood: hence also
the great practical importance of thorough disinfection and destruction of primary
and other foci. He considers that great numerical strength of hæmic microbes has
a very unfavorable prognostic significance (*vid.* Eiselsberg's studies, Lecture, II),
even in the absence of metastases about internal organs, the converse of this being
also true. He thinks too that the bacillus pyocyaneus is rather a constant follower
of the streptococcus, belonging more to the saprophytes, and invading s il pre-
pared for it by other bacteria.

Manfredi and Traversa would seem to have discovered the
explanation of certain peculiar symptoms, coma, cramps, etc.,
noted occasionally in severe cases of erysipelas. They experi-
mented on numerous animals with bouillon cultures of the
streptococcus erysipelatis which had been sterilized by filtra-
tion. They found that there were remaining in the solutions
apparently two ptomaines, one having the property of produc-
ing paralytic pneumonia, the other of causing cramps and
epileptiform convulsive movements. These ptomaines seemed
best formed when oxygen was excluded, oxygen seemed to
reduce them.

I have, for years, endeavored to find a pathological basis for
the clinical distinction which an accurate diagnostician
should make between genuine erysipelas, whose biological
cause is well known, thanks to Fehleisen, and cases of what
may be and often is called *cellulitis*, or perhaps the *erythema
exsudativum multiforme* of Hebra.

I have made cultures and examinations from a number of
these latter, and while I have never found such uniformity of
results as would permit me to draw any permissable conclu-
sions, so far as specificity is concerned, I can at least say that

such cases as run a different clinical course are in all proba-
bility pathologically different. That is to say that I have
never found erysipelas cocci when this disease failed to declare
itself clinically. On the other hand I have found in these
other cases sometimes nothing, and once or twice either
staphylococcus forms or some organism whose identity I
failed to make out.

This is quite in accordance with Cordua's studies. (*Zur Ætiologie des erythema
multiforme, Deutsche med. Woch.*, 1885, No. 33, p. 576.) He investigated fifteen
out of one hundred and twenty-seven cases of skin affection of the hand and fingers
resembling erysipelas. Its resemblance as well as the fact that it was met with in
patients peculiarly exposed, *e. g.*, cooks, butchers, oyster-openers, etc., led him to
undertake the examination. From these fifteen patients he excised small bits of
skin and placed them upon agar in the oven. From these he obtained a coccus re-
sembling staphylococcus pyogenes albus save that it was three or four times larger.
Upon animals it was inactive. He twice inoculated himself, with the result that at
each point he produced a dark red swelling of the skin resembling the original dis-
ease. He likens it to Rosenbach's "*Finger-erysipeloid*" without establishing its
identity therewith; and is rather of the opinion that different organisms may produce
the same cutaneous disturbance.

Two years later in *Langenbeck's Archives*, 1887, Rosenbach more fully described
the cutaneous disease which he termed *erysipeloid*, which appears much like Cor-
dua's *erythema multiforme*. The microbe of this disease Rosenbach first supposed
to be a coccus, but after studying it further determined that it belonged to the
chladothrix group. It grows best on gelatine at 20° C., but very slowly, and in this
medium it most resembles in growth the bacillus of septicæmia of mice. In form it
is like the cladothrix dichotoma, but smaller. By inoculation of a pure culture
Rosenbach produced an attack of erysipeloid upon his own arm.

Repeated endeavors to implant it upon lupous skin, in order to eradicate the
specific ulceration, were fruitless.

9. *Bacillus pyocyaneus.*—This is the organism which oc-
casionally gives to pus its greenish or bluish tint. It is one of
the most active of the pyogenic germs, and up to the present
has only been found in connection with man. That the organ-
ism is of some importance and interest to pathologists, is evi-
denced by the recent work of Charrin, "*La Maladie Pyocy-
anique,*" which appeared in 1889. Ledderhose was among the
first, perhaps the first, to establish that the bacillus pyocyaneus,
which had hitherto been supposed to be simply a saprophyte,
was in effect a pyogenic organism.

About the same time Pawlowski showed the same fact, and
it was found that Koch had learned that it was fatal when in-

jected into the peritoneum of the guinea-pig. While the statement above made, as to its never being met with except in man, is true, it nevertheless has powerful pathogenic properties when inoculated upon the lower animals.

Ernst has distinguished two varieties of this bacillus, which he denominates alpha and beta. They agree in morphology, but he has described a peculiar "chameleon phenomenon," which only the beta form presents in potato cultures. When such a growth upon a potato is disturbed with a needle, in from two to five minutes a change of tint is discovered, the reddish brown tone merging into a leaf-green. This seems to be so constant as to constitute a genuine po nt of distinction and to furnish a possible argument in favor of Naegeli's views concerning the mutability of species.

This organism, as it grows, generates a coloring matter which gives as characteristic a tint to cultures as to the pus, and which has been isolated by Fordos and been called *pyocyanin* (vide Lecture I.). This is a crystallizable substance; beside it another substance called *pyoxanthin* has been isolated by the same observer. Pyocyanin in alkaline solutions gives a blue, or in acids a red tint. A third coloring matter has been described by Babes, which gives by transmitted light a reddish brown, by reflected light an emerald green tint. It is soluble in water, and insoluble in chloroform. In acid solutions it gives a steel gray color. When these are made alkaline, the dichroism returns. It appears to be composed of two separate ingredients, one of which is soluble in alcohol, the other not. He also separated an aromatic substance whose odor reminds one of linden blossoms. These studies he made upon the beta form of Ernst. Pyocyanin is the most easily studied of these various substances, and is only mildly, if at all toxic. Minute crystals of it can be sometimes seen upon the surface of cultures. Its formation is not a regular nor a necessary accompaniment of the growth of the bacillus; it grows only under peculiar conditions, and the secretions of the skin appear to favor its formation.

10. *Bacillus pyogenes fœtidus.*—Passet found this organism in an abscess in the neighborhood of the rectum. It is by no means peculiar to peri-intestinal abscesses, however, since I have myself once found it in an abscess of the brain, and have met with it in abscesses from other localities. It is a short,

plump bacillus, which forms a white surface growth, and gives off a disgusting odor. On potatoes it forms a brownish mass. It does not liquefy gelatine. It grows in milk, but does not generate an odor. It is pathogenic in mice and guinea-pigs, but not in rabbits. The injection of a few drops of culture in the former animals causes septicæmia.

FACULTATIVE PYOGENIC ORGANISMS.

The gonococcus.—This organism figures, of course, most prominently as the sole cause of true or specific gonorrhœa. Discovered first by Neisser, it has since been the subject of a vast amount of study, of which the most fruitful part has perhaps been done by Bumm. He, more than any other, has demonstrated its specificity, and has stamped gonorrhœa as ranking among our best known parasitic diseases.

The gonococcus is a coccus, commonly met with in pairs, otherwise a diplococcus, presenting a double-biscuit shape or arrangement which of itself is quite distinctive. It is never found in chains, but frequently in tetrads, though it is not regularly thus grouped like the micrococcus tetragenus.

Nuclear stains, like the basic aniline dyes, do not make a deep impression on these cocci. Such stains as vesuvin or Bismarck-brown may answer well enough for cover glass preparations but do not suffice for sections. It is noteworthy, and in certain respects a valuable diagnostic point, that they loose their aniline stain when prepared according to Gram's method. While they share this peculiarity with certain other forms they may be differentiated from the pyogenic cocci by this sign, which consequently is of value.

Their most marked peculiarity is their power of penetrating living protoplasm and propagating there. Scarcely any, perhaps none, of the other pathogenic cocci have this property. In examining gonorrhœal pus the pus-cells will be seen to contain numerous groups of diplococci, which may have proliferated so rapidly as to completely fill the cell.

The gonococcus is well nigh the most difficut of all the common bacteria to cultivate. At first it was believed that the gonorrhœa-germ would grow upon the ordinary nutritive gelatine; then it was found that this was an error, and that they would grow only upon coagulated blood serum, or gelatine-

serum, and furthermore that they thrive to best advantage only upon human-blood-serum.

It has been claimed that upon agar to which has been added 2 to ·5% of Kemmerick's peptone they could be cultivated, but it has been found that this statement is not in accordance with fact. Also upon potato it can be scarcely grown. Even upon a suitable medium it is most difficult to cultivate.

It must be deposited in relatively large quantity and in pretty pure form. That is, if planted along with common pyogenic cocci they appear to prevent its growth. The temperature must be maintained at 33°-37° C. and new cultures must be made from day to day. The cocci die out in two or three days in cultures. Nevertheless Sinnety and Herneguy (*Progres Medical*, 1885, No. 33.) have shown that they may live inside the living body after the active disease has been apparently subdued by antiseptics; since in some of their patients they found the cocci a year after the apparent subsidence of the disease. The well known statements of Noeggerath are in perfect accord with these.

The investigations of Neisser, Bockhardt and Bumm make it indisputable that gonococci call forth an active purulent discharge from the mucosa of the genito-urinary tracts. They penetrate between the epithelial elements to the papillary layer. By the second day a lively emigration of the white corpuscles begins. The epithelial layer is thereby elevated from its base, and between them is formed a fibrinous exudate, exceedingly rich in cells, which later are loaded with cocci. Epithelial regeneration, in the average case, begins in four days and should be fairly complete in twenty. It appears that mucous membrane which is covered with cylindrical epithelium is most likely to suffer from this parasitic attack (urethra, uterus, glands of Bartholini, conjunctiva), while that provided with flat epithelial cells (mouth, nose) for the most part escapes.

According to Bockhart the acutest period of an attack of gonorrhœal catarrh is that during which there is the liveliest contest between the gonococci which have penetrated the mucosa and submucosa and the numerous leucocytes that are a part of the copious exudate which infiltrates the connective tissue.

The whole history of a gonorrhœal attack exhibits that we have to do with an irritative cause affecting a surface, as in the case of erysipelas, which in both cases commonly disappears without leaving permanent injury to the tissues; and that it is only exceptionally that the deeper tissues suffer, or those of internal organs by secondary localization. Such complications as epididymitis, endometritis or salpingitis are caused by spreading along continuous surfaces.

Bumm has done more than any one to study the nature of gonorrhœal mixed infection. The most common contaminating agents are the pyogenic cocci. Such mixed infections can take place in the female:

1. In Bartholini's glands. Here not only pyogenic but saprogenic cocci as well as the gonococcus can easily penetrate. Abscesses as well as retention cysts may occur here.

2. In the urethra. Urethral abscesses of either anterior or posterior wall occur by means of infection of the glands.

3. In the bladder. A true primary gonorrhœal infection of bladder epithelium is not known. The cystitis is of pyogenic origin and usually an extension from the urethra.

4. In the cervix. Suppurative parametritis is the analogue of acute gonorrhœal bubo in the male, which is always due to pyogenic action. Whether it is truly an infectious or an irritative process is yet an open question.

5. In the so-called gonorrhœal rheumatism (arthritis), which, as manifested especially in the knee, yields a fluid which shows a mixed infection.

6. Tubal-tuberculosis is probably often to be regarded as really a gonorrhœal mixed infection.

Indeed it is scarcely even doubtful whether such destructive lesions as those which lead to formation of stricture or suppurating bubo can be caused by gonococci alone; on the contrary it is extremely probable that these never occur without the participation of the common pyogenic cocci. The experiences of numerous observers, the writer included, show that the staphylococci are often to be found in the urethra, and such rare cases as one which I have elsewhere reported (*Jour. Cut. and Venereal Disease*, December, 1888, p. 441) show that pyæmia following gonorrhœa is not unknown, while the true

pyæmia itself is not to be explained except by the action of the common pyogenic organisms. In fact one may accept the general statement that gonococci exert a true pyogenic action only upon certain mucous surfaces; and that beneath such surfaces they do not find the conditions necessary to their growth. They are ærobic in high degree, and it would appear that only epithelium and not connective tissue cells possess the required chemical character. Bumm found that injections of pure gonorrhœal pus into the tissues were harmless, as were also pure cultures. Indeed if 24 hours after injections of such material we cut into the part and remove some of this same pus we shall find that while pus cells still remain the gonococci have disappeared. This is a matter of great interest, showing that pus cells—apart from the bacteria which they contain, do not exert a pyogenic action. (Vid. Lect. II.)

Kitt has determined an analogous fact in connection with the mastitis of cows. The peculiar organisms only exert their pathogenic action when they are present in the ducts or acini of the gland, *i. e.*, upon its epithelial covering; if injected directly into its tissue they cause no suppuration.

Bockhart, in 1886, described a "pseudo-gonorrhœal urethritis" of moderate severity only, caused by a diplococcus that was met with also in vaginal secretion when it was *not* of acid but of alkaline or neutral reaction. It has nearly the same biscuit form as Neisser's coccus, is very small, is met with sometimes alone, sometimes in groups of two to six, usually in the fluid and not in the cells. It does not collect in such clusters as does Neisser's coccus. It grows on agar at 30°-32° C., but better on serum. Inoculation on the healthy urethra in two instances evoked a mild urethritis. In connection with this form of urethritis he describes also a "pseudo-gonorrhœal epididymitis."

Schwarz does not hesitate to express himself very positively that gonorrhœa is the only infectious catarrh of the female genitals; the bearer of the contagion, or rather the contagious element itself, is Neisser's gonococcus. Any secretion in which it is not found is not so. Without gonococci there is no gonorrhœa; all manifestations of gonorrhœa are connected with its activity; they are pathognomic evidences of the disease. (Die gon. Infection beim Weiber, *Volkmann's Saml. kl. Vort.*, No. 279.)

But this view of Schwarz fails to account for numerous cases of "bastard-urethritis" where inflammation runs high, where bubo is common, but where Neisser's coccus is not found in the

pus. That these cases present sufficiently acute features will be attested by numerous patients. Whether these are provoked by Bockhart's diplococcus, or whether an acute urethritis can be engendered by staphylococci is not yet determined.

In the *Centblt. f. allgemeine Pathologie*, Vol. i, No. 18, Pellizzari has made a contribution toward corroborating the view that there is no real abscess produced by the gonococcus, but that all the suppurating buboes, and other abscesses appearing to be provoked through the influence of the organism are in reality mixed infections. He reports three cases of peri-urethral abscesses which appear to have been caused, as usual, by extension of the inflammation from the urethra into one or more of the urethral follicles, in all of which the pus proved to be a mixture His paper constitutes interesting reading, and serves as a further corroboration of views already expressed.

The most significant other feature of true gonorrhœal disease is its occasional sequelæ in the shape of post-gonorrhœal arthritis, whose most conspicuous sign is an effusion into the joint cavity. This sometimes is a thin serum, and sometimes it is quite fibrinous or flocculent.

In 1885 I read that Petrone had recognized gonococci in this fluid. Soon after this I demonstrated this discovery by preparations from a patient of my own. Kemmerer, Affanasiev, Bergmann and Smirnoff, as well as others, have done the same thing. In view of such discoveries it would appear impracticable to explain these arthritides—or at least all of them—upon the ground of reflex irritation from the urethra, although there is no denying that we do meet with joint effusions after mere catheterization. Of course true suppurative arthritis is only to be explained by the theory of mixed infection already alluded to.

The pneumonococcus.—Two or three different organisms have been described under this name. That, for instance, of Friedlaender, which has a capsule, and that of Fraenkel which grows like Sternberg's coccus from saliva, and perhaps one other form. This organism certainly is not commonly pyogenic, but that it may prove itself so occasionally is placed beyond doubt by the investigations of several observers. For instance, Fraenkel, like Talamon and Salvioli, has found his pneumonococcus in cases of empyæma following pneumonia, and has come to the conclusion that this sputum-septicæmia coccus is a common and frequent cause alike of pneumonia and

of these subsequent diseased conditions. It concerns us most in this relation to know that under certain circumstances it may show a true pyogenic activity. It has also been found in pus from cases of combined pneumonia and meningitis, the intracranial pus being found to be a pure culture of the microbe. These statements are corroborated by Foa and Bordoni-Uffreduzzi.

Gabbi and Puritz have identified the diplococcus of Fraenkel in the pus from a peri-articular abscess occurring in a case of acute pneumonia. Pus from this abscess injected under the skin of a rabbit produced acute septic symptoms, of which the animal died. In its blood the same coccus was also found. This appears to be the first case of peri-articular inflammation recognized as being caused by Fraenkel's pneumonia coccus. Hitherto only cases of arthritis have been described by Weichselbaum, Belfanti, Monti and Santer, all of whom have found it in pus from the interior of joints in complicated croupous pneumonia. (*Centblt. f. Bakt.*, viii, No. 5.)

Injections of it into the knees of animals have almost invariably produced purulent arthritis. After injecting cultures into neighboring tissues, and then injuring the joint surfaces with sterilized needles, thus making a point of least resistance, the results were less certain though frequently successful. Gabbi compares the inconsistency of these results with the great infrequency of joint complications in pneumonia. Weichselbaum found this same coccus in three cases of peritonitis. In one of them it followed a pneumonia; in the second a double pleurisy; in the third it was idiopathic. It will be remembered that Fraenkel's coccus is the same as the *micrococcus Pasteuri* of Sternberg.

In the early part of this century it had been noted by Dr. B. W. Dudley, of Kentucky, that during an epidemic of typhoid pneumonia which devastated the central portion of his native state many cases were followed by a "bilious fever characterized, like the plague, by a tendency to local affections. Abscesses formed among the muscles of the body, legs and arms, and were so intractable that limbs were sometimes amputated to get rid of the trouble."

The pseudo-pneumonococcus of Passet.—He found an organism in the pus of acute abscesses, which closely resembles Friedlaender's pneumonococcus. He met with it once in a small acute abscess of the back, and once in pus from the knee joint of a patient who sickened and died of croupous pneumonia. In the former instance he found it alone, in the latter in connection with other organisms.

It forms grayish-white, semi-circular elevations on the surface of gelatine, and in the earlier stages of growth is indistinguishable from Friedlænder's coccus, but at a later period recognizable differences appear both as regards growth and effect upon animals. In pure cultures it does not grow along the needle streak, hence it is aerobic. On potatoes it gives off no gas, and mice inhale it without disturbance. Injected into the pleural cavity of mice and rabbits, it causes pleuritis. When injected subcutaneously it often produces abscesses in mice and rabbits, while Friedlænder's coccus is not pathogenic for rabbits.

Micrococcus pyogenes tenuis.—This was first described by Rosenbach, who found it in three cases of deep suppuration. Since he described it not a single observer has met with it till Dr. Maria Raskina, of St. Petersburg, succeeded in isolating it from the pus and organs of an infant dying of severe scarlatina, complicated with pyæmia, on the 18th day.

The pus from the metastatic abscesses was found to be almost a pure culture of this coccus, while the parenchymatous juice of the various organs contained beside it a large diplococcus of unknown biological position. Inoculations of pure cultures of the pyogenic coccus under the skin of rabbits gave negative results, though the blood of the animals showed the presence of the coccus for at least twenty hours after injection. Hence the true pyogenic power of the organism is somewhat problematical, Rosenbach's researches failing to demonstrate it. Dr. Raskina considers that it may belong to the group of so-called *metabiotic* microbes of Garré; that is that it occurs only secondarily after suppuration has been caused by some other coccus. Nevertheless she states, as above, that the pus from her case seemed almost a pure culture of this same organism. (*Trans. of the Third Gen. Meeting of Russian Physicians,* 1889; Abst. in *Manchester Med. Chronicle.*) On agar it forms an extremely delicate, well nigh invisible layer. The individual organisms are somewhat irregular in shape, and average larger than the streptococcus pyogenes.

Rosenbach's oval coccus.—This observer found in one case of acute suppuration an oval coccus, which rapidly liquifies gelatine, and produces pus when injected into the eyes of rabbits. It has not been further studied, nor even given a name.

The glanders bacillus (Bacillus malei).—Rudenko after carefully studying the lymph glands in cases of lymph-glanders produced abscesses by injection of pure cultures of glanders. The pus from these abscesses he also found to be a pure culture of the injected microbes. Consequently we must include this organism among our pyogenic forms. He always found the neighboring lymph glands to be infected with them.

Bacillus of malignant œdema (Vibrion septique).—Whether the bacillus of malignant œdema really deserves to be grouped with pyogenic organisms, is not yet known. It has been found in pus, however, as, e.g , a very interesting report by Braatz shows.

In a case of progressive gangrenous emphysema of the cervical region he evacuated a quantity of very offensive, gaseous, sero-purulent fluid. In this fluid the bacillus was found along with staphylococci and streptococci. The most interesting feature of this case is that the patient, an ignorant peasant, had a swelling under the jaw first, and then, by advice of his wife, drank a glass of chamomile tea in which he had put a table-spoonful of rat fæces. When we remember the liability of the rat to this disease we seem to see an explanation for the development of the same in man.

The bacillus tuberculosis.—This organism is not commonly enumerated as among the pyogenic, yet it is indisputable that it can produce abscesses whose contents are pure cultures. Thus, for instance, Fraenkel has carefully reported a case of brain abscess in whose contents the tubercle bacillus was the only organism found. That such collections of pus were not originally mixed infections is apparently proven by the fact that they become infected with pyogenic organisms so soon as they became exposed, as by incision.

It is hardly credible if one group of staphylococci, for ex-ample, had exhausted the fluid contents of such a cavity and then died out in it, that another group could later live and thrive in the same fluid. Fraenkel's deduction was warmly contested by Baumgarten, who claimed that he did not prove his case, that he no doubt had a tubercular focus in the brain, but that its detritus was not true pus, but pseudo-pus, con-sequently that the tuberculous bacilli were not entitled to be considered as truly pyogenic. However Baumgarten's objec-tion must fall in the light of the reasoning above given. Whether such organisms as the tuberculosis bacillus shall pro-duce abscesses or not is largely a question of time. In vi ru-lent *milzbrand* the poisoning of the system is too rapid, and the animal dies before the anthrax bacilli have time to act, but when a Guinea-pig is inoculated with attenuated virus, and then dies six, eight or ten weeks later, one finds not only infarcts and metastatic processes, but multiple abscesses whose contents are pure cultures of anthrax bacilli. The same is known also of the typhoid bacillus, of the pneumonococcus, of the bacillus of tetanus, and this general statement also holds good for

tubercle and for septicæmia.   We have *foudroyante* forms
where the specific element kills before abscesses have time to
form, and we have other slow forms with the well known ab-
scesses.   In all these cases it is not so much a question of the
pyogenic powers of certain bacteria, as of the time during
which they are permitted to act.   The bacillus of tetanus, for
instance, is never found without the presence of pus, so far as
I know, at least in the human organism, yet its main influence
lies not so much in its pyogenic as in its tetanizing powers.
The bacilli get into the divided cord of the new-born from the
midwife's rusty shears, or dirty hands, or from the dirty rags
bound around it, and the tetanus of the new-born in no sense
differs from the traumatic forms.

Tetanus bacillus.—Inasmuch as it is proposed to devote a
good portion of Lecture V. (q.v.) to this organism, it will be
unnecessary to do more than to simply mention it here as
among the facultative pyogenic species.

Typhoid bacilli.—When, later in this course, I shall, as I
hope, take up the topic of *Mixed Infection*, I shall have more
to say upon these bacilli as pyogenic organisms.   Golzi had
opportunity to observe a case of acute osteomyelitis during
the course of a relapse of typhoid fever, and in the pus found
typhoid bacilli and no other organisms.   He then experi-
mented with pure cultures of bacilli, and found that if he first
broke the femur and then injected them he determined an ab-
scess at the seat of fracture nearly every time.   He concludes
that these organisms are much more disposed to produce sup-
puration in rabbits than in man. (*Lo Sperimentale*, June, 1890).

Orloff has devoted no little time to a careful study of the
suppurations which complicate typhoid. (*Centrlblt. f. Bakteri-
ologie*, 1890, viii, No. 12, p. 360, from *Wratsch.*)   They occur
most frequently in the skin-boils, in the subcutaneous areolar
tissue-abscesses,   particularly   when   there   are   pressure-
sores; also as abscesses of the larynx in the connective tissue
around the trachea and in the mediastinum; less often in the
muscles (rectus abdominalis and glutæi), the more external
lymphatic glands, the thyroid and salivary glands and the
bones and joints.   The latter terminate sometimes in diastasis,
and sometimes in exostosis or suppuration.   Sometimes one

bone or joint suffers, sometimes several ; more commonly in younger patients. The exudate is sometimes serous, at others sero-purulent or absolutely purulent. Of internal suppurations perhaps the more common is empyæma, though abscesses occur in liver and spleen ; these suppurations are not grouped with disintegrations of mesenteric glands, nor with rupture of splenic or ovarian infarcts.

Investigators generally incline to the view that most of these suppurations are really mixed infections, though undoubtedly typhoid bacilli alone may provoke formation of pus.

But Orloff decided to settle this matter by a series of experiments which could not be mistaken. He undertook (1) to determine by injections of pure cultures whether typhoid bacilli could call forth pus ; (2) whether, if so, it was by virtue of their own presence or by their products, and whether, if not, the injection of mixed cultures produced any modification by action one upon the other. These experiments appear to have been conducted with most scrupulous attention to details, which, however, it is hardly necessary to describe just here. His conclusions were carefully deduced from amply sufficient data and bear the stamp of reliability. They are :

1. Injections of typhoid bacilli (pure cultures) into various tissues (joints, muscles, etc,) produce active round-cell infiltration and violent suppuration.

2. The same results, though much less acute, follow injections of sterilized cultures; whence follows that :

3. The chemical products of these organisms are, at least in no inconsiderable degree, the causes of these manifestations.

4. Suppurations occurring during typhoid or during convalescence, whose pus contains only typhoid bacilli, depend entirely upon them for their provocation, and are not to be regarded as mixed infections.

Further confirmation of this view comes occasionally also from yet other sources. Thus, Achalme (*La Semaine médical*, 1890, No. 27) reports a case of periostitis of the tibia as a sequel of typhoid. Typhoid bacilli were found in the pus and no other organism.

Micrococcus tetragenus.—This is an organism from the mouth, known to be present in pulmonary abscesses in consumptives, as

a contamination   So far as I know the first recognition as a form which *per se* could produce pus was a case which I reported in *The Medical News* in 1888. It occurred in a young woman with a peculiar form of submaxillary and cervical phlegmon of exasperatingly slow course, in the pus from which I found this coccus and this alone, and in which the path of infection from a badly diseased tooth could be traced.

It is known to possess pyogenic properties in certain small animals.

Zuckermann, writing in 1887, condensed the results obtained from a study of 495 acute abscesses.   According to these staphylococci were found in 71%, and streptococci in 16%. In 5$^1/_2$% both were found together.   In the balance of cases other forms were found.   These results vary but little from the more recent studies of Steinhaus.

Some two or three years ago I presented to the American Surgical Association a table showing my findings in about 50 purulent cases.   I have since more than trebled the number, but present herewith a table of only 100 cases, in which, among other things, will be found, *e. g.*, my justification for some of the statements made in the previous lecture.   (Absence of organisms in the archepyon of cold abscesses, etc.) These 100 cases are selected only in this respect, that I am prepared to vouch for the accuracy of the results; which we cannot always do.   (See Table).

Anthrax bacilli.—These, as a rule, especially in man, do not alone provoke suppuration, but abscesses which contain them appear to be the result rather of mixed infection.

But there is some reason to think that even in man, and much reason to believe that in animals they may, exceptionally, act in a purely pyogenic capacity.

Actinomycosis.—Pathologists were for some time in doubt as to whether actinomycotic abscesses were not all truly mixed or secondary infections.   This matter I believe is now set at rest, and it is definitely settled that rarely these fungi provoke suppuration without aid from other organisms.

Szénásy, in the first case of actinomycosis recognized in Hungary, met with a painful fluctuating swelling of the right mamma. By aspiration he withdrew tenacious pus in which were found typical actinomycotic forms; which were also found in the sputum. (*Centblt. f. Chir.*, 1886, No. 4.)

TABLE.

Disease.	Number of cases.	Staphylococcus pyogenes albus.	Staphylococcus pyogenes aureus.	Staphylococcus pyogenes citreus.	Staphylococcus cereus albus.	Staphylococcus cereus flavus.	Streptococcus pyogenes.	Bacillus pyogenes fœtidus.	Micrococcus tetragenus.	Streptococcus erysipelatis.	Bacillus fluorescens liquefaciens.	Bacillus anthracis.	Bacillus fluorescens putridus.	Bacillus urœliquefaciens.	Bacillus of green pus.	Bacillus coli commune.	Bacillus pseudo-pneumonicus.	No growth.
Abscesses	32	15	21	2		5		2	1	1				1				
Caries	3	2	2		1	1	1											
Necrosis	7	3	4		1	2												
Ulcers	4	2			2		2				1							
Ulcer, syphilitic	1	1			1		1											
Chancroidal pus	2		1			1								1				
Pus from bubo	4	3		1			1							1				
Discharge from chronic gonorrhœa	1	1																
Pustules	5	2	4															
Carbuncle	3	1	1				1	1			1							
Phlegmon	1	1			1													
Cellulitis	1	1		1														
Erysipelas	2	1								2								
Felon	1	1	1	2														
Empyema	6	1	2			2												
Gangrenous phlegmon	1	1	1			1												
Tetanus	3	3	1		1		1											
Pyæmia	1	1			1													
Hypopyon	1	1																
Gall-bladder abscess	2															1	1	
Abscesses, cold	9																	9
Hæmatoma, material from	1																	1
Tubercular testicle	2																	2
Tubercular lymphnode	2																	2
Enlarged thyroid	1																	1
Central osteo-myelitis	1																	1
Tuberculosis of bone	2																	2
Post-operative sarcoma	1						1											
Total	100	41	38	6	12	7	11	2	1	2	1	1	1	1	1	1	1	18

Aspergilli.—The same is true of two varieties, at least, of aspergillus ; and it is claimed that spirochæte may provoke suppurative otitis media.

In 1877 Grawitz described a purulent inflammation in rabbits' eyes which he had experimentally created with this fungus. In 1881 he injected it into rabbits' blood and subsequently recovered it by culture methods from the liver, kidneys, etc., and demonstrated for the first time that it might act as a pure pyogenic organism.

And were we considering suppuration in animals rather than in man we should have to include such microbes as those which cause contagious acne in horses, the various septicæ-miæ in different animals, etc.

Following I purpose to mention, without attempt to classify them specially, several forms of organisms which have been met with in pus from various human sources. In 1885 Tilanus reported two cases of compound fractures of the leg, which ended in gangrene. From the gangrenous tissue of one he sep-arated a new bacterium which he termed *bacillus gangrenæ;* from the second another, to which he gave the name *micro-coccus fœtidus.* After experiments therewith and failure to get any inoculation results, he regarded them as saprophytes, rather than pathogenic microbes, which, nevertheless, gener-ated the ptomaines by which the patients were fatally poisoned.

Kartulis has found in fresh pus from abscess of the liver consequent upon dysentery, the dysenteric amœba which he had previously described as having been found in cases of acute and chronic enteritis among the Egyptians, but along with it were found the common pyogenic cocci, and he makes no claim that the amœba had anything like a pyogenic action. This naturally calls to mind the recent discovery of Prof. Os-ler, who has, within a year, reported a number of observations on pus from hepatic abscesses in which could be still seen ac-tive and moving amœboid organisms. Enough study has not been given to these, so far as I know, to permit a statement as to whether they are or are not in effect pyogenic organ-isms, though I presume that they are.

A few years ago Netter determined that after ligature of the ductus choledochus, the previously sterile contents of the gall-bladder contained bacteria, and by ordinary methods he made out two species of organism, one the well known staphylococ-

cus pyogenes aureus, the other a short bacillus, which he, for the first time, described, and which he identified as the same which he and Martha found in an hepatic abscess consequent upon gall-stone (*Archives de Physiol. norm. et pathol.* 1886, No. 5, p. 7). This case was complicated with ulcerative endocarditis, and the same bacillus was found in the cardiac valves. They regarded it as an inhabitant of the intestine which wandered into the gall duct, favored by the obstruction above, then into the liver tissue, and thence into the blood, causing both the abscess and the valvular lesion. They found, furthermore, in literature five other cases of combined biliary obstruction and verrucous or ulcerative endocarditis, and they consider that this bacillus possesses possible pyogenic properties.

Netter, in this latter communication, claims that hepatic abscesses, caused by staphylococcus alone, are accompanied by others in other organs, while those caused by his peculiar bacillus are marked by a lowering of temperature, even to 34° C., and cellular changes in the liver. In mixed infection we have a combination of symptoms. Injections of staphylococcus cultures produce the now well known pyogenic effects; injections of cultures of his bacillus caused disseminated, hyaline degeneration of liver cells. He has also met with this bacillus in the biliary passages of another patient after biliary obstruction, without abscess, beside the case reported by himself and Martha. (*Progrés Médical*, 1886, Nov. 13. p. 992.)

It occurred to me last winter to meet with a case of abscess of the gall-bladder from which I removed 104 gall-stones, in the pus from which I found a bacillus which tallies in every respect, so far as I can learn, with that described above by Netter; having only Netter's somewhat vague description to go by, I am unable, positively, to identify it as the same, though I have no doubt of it.

Hauser (*Ueber Faulnisbakterien und deren Beziehung zur Septicæmie*, Leipzig, 1885) describes three forms of saprophytic bacilli, which he terms Proteus vulgaris, Proteus mirabilis and Proteus Zenkeri. They are characterized in part by a certain pleomorphism, which he, perhaps, unduly exaggerates, and by a peculiar "schwarmstadium," by which is meant that in 5% gelatine they make sudden and extensive changes of locality,

that they *swarm*, as it were. That they are certainly sapro-
phytic in action, he placed beyond a question. He further
showed that they produce a very active ptomaine, which, in
small quantities, exerts a marked toxic effect, causing in living
animals all the phenomena of putrid intoxication, increased
pulse and temperature, emesis, cramps, cyanosis, collapse and
death. That they possess pyogenic properties is not demon-
strated. It, moreover, appears that they are not harbored
nor nurtured in the living tissues and fluids of healthy animals.

Chantemesse examined carefully a few cases of Delhi boil
(*"bouton du Nil"*), and isolated a coccus which, in many re-
spects, resembled the staphylococcus pyogenes aureus, but
which was slower in liquefying gelatine and more quick to as-
sume a yellow tint, and which grew a little differently on potato.

Inoculated upon two human arms, in pure culture, it pro-
duced each time a furuncle, which changed to an ulcerating
nodule, the ulcer being crateriform, and rapidly healing under
sublimate dressings. The pus from this furuncle was a pure
culture of this "microbe du clou du Nil." Upon rabbits it
was sometimes rapidly fatal, sometimes produced chronic le-
sions, resembling those upon men. (*Annales de l'Institute
Pasteur*, 1887, No. 11). This must be consequently reckoned
as one of the pyogenic forms.

Netter investigated twenty five cases of suppurative menin-
gitis. Four times he could trace it to aural disease, once each
to the sphenoidal and ethmoidal cells. In eleven cases it was
metastatic, the primary focus being twice in the placenta, once
in the pleura, and eight times in the lungs. He found the fol-
lowing bacteria which he considered as the active agents in
producing the suppuration:

Diplococcus pneumoniæ in sixteen cases.

Streptococcus pyogenes in four cases.

Diplococcus intracellularis in two cases.

Bacillus pneumoniæ (Friedlaender ?) in one case.

A short mobile bacillus, identical with that found by New-
man and Schaffer in meningitis, in one case.

A small curved bacillus that could not be cultivated, in one case.

He consequently maintains that suppurative meningitis can
be caused by *various* bacteria, whereof the diplococcus pneu-

moniæ is most common. He, further, thinks it possible to distinguish the bacterial factor by the clinical course of the disease, and the character of the exudate. When the diplococcus pneumoniæ was found the exudate was green and viscous; when the streptococcus was found it was less adherent and more sero-purulent.

Other investigators have found the diplococcus pneumoniæ in twenty-seven cases of forty-five examined, the streptococcus six times, the diplococcus intracellularis ten times, and the bacillus of Newman and Schaffer once.

This latter form much resembles the typhoid bacillus, morphologically, yet is distinct. Its discoverers claim that sterilized cultures of it cause not the slightest local disturbance; consequently the idea advanced by Grawitz and DeBary that ptomaines are unnecessary for the production of pus seems to be scarcely borne out in this instance, since this is a pyogenic agent.

While throughout these lectures and without evasion, we have taken the position that *there is, clinically, no suppuration without the action of microorganisms*, we must also insist that this expression is not intended to imply *bacteria* alone, since such other living organisms as that of actinomycosis, several of the molds, and the amœboid organism recently described by Osler, can produce it. And in the lower animals it is probable that numerous of the protozoa, as well, can provoke it. It has been stated that the injection of metallic mercury under the skin, especially of syphilitics, will produce the same result, though when the evidence to this effect is sifted, it is not found to be above criticism.

But in an inquiry of this kind it is not so importaut—though still most interesting—to study the rarely or unusually and uncommonly pyogenic organisms as to determine, if possible, under what circumstances the well-known pyogenic forms produce pus.

In 1861 Verneuil expressed the idea that liquids contained in the hernial sac contained toxic or irritating matters. In 1867 Nepveu found cocci in such fluid. At the Congres de Chirurgie, in 1889, Clado, of Paris, took up the question. In the contents of a sac which had contained a strangulated her-

nia (fatal one hour after operation), he found numerous mobile bacteria. The next day, at the section, these were found in the blood, lungs and spleen. In the strangulated knuckle there were the same microbes as in the blood, lymphatics and glands. The cultures furnished one special bacterium which, cultivated at 28° C., proved inoffensive, but cultivated between 37° and 40° became mortal within a few hours. Inoculation into the blood caused death in series. It was particularly pathogenic for guinea pigs and rabbits. In the dog it caused vomiting and loss of appetite followed by recovery. It multiplied in bodies of animals with astonishing rapidity. Clado accounts for the rapid death of some hernial cases by its penetration into the economy, taking its starting point from the surface of the intestine. Visceral congestions, so frequently observed, are the result of its localization, particularly in the lungs. Post-hernial peritonitis is held to be due to its migration through the intestinal parietes, the distention of the knuckle by gas being supposed to favor mechanically their penetration into the mucous membrane.

Bönnecken has carefully examined the fluid contained in the sac in eight cases of strangulated hernia in men, as well as in several dogs in whom it was artificially produced. In every one there were found numerous micro-organisms which proved to be identical with those ordinarily found in the intestine. A venous stasis appeared to be the pre-requisite for first the escape of fluid and then its infection. Beside the ordinary bacterium, he met with Miller's *micrococcus aerogenes*, and Escherich's *streptococcus coli brevis* and *gracilis* and *bacterium lactis aerogenes*. These bacteria were also found in the tissues and on the serous surface.

The circumstance that these same forms were found in the peritoneal cavity and in the heart's blood, means that death was caused by peritoneal sepsis and absorption of poison before pus had time to form. The author consequently holds a careful disinfection of the sac and the included loop or loops of intestine, before relieving strangulation, to be urgently indicated. (*Virchow's Archiv.*, cxx.)

Abundant corroboration of the practical value of this deduction comes from many sources. Velpeau showed that the fluid contained in the sac of an incarcerated or strangulated hernia produced an irritating effect upon the hands of the operator, and many observers since him have noticed that the escape of this fluid into the peritoneum gives rise to peritonitis without there having been any injury to it sufficient by itself to produce it. The investigations of Clado confirm those of Bonnecken; when he inoculated dogs with this fluid or its con-

tained bacteria he produced rapid death, with symptoms of violent intoxication.

Verneuil has given to this condition the excellent name of stercoral intoxication.

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THE GERM THEORY OF SYPHILIS FROM A CLINICAL POINT OF VIEW.

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THE theory of the microbic origin of syphilis occupies a very peculiar position. No one doubts it and yet although a similar source is proved of many diseases in which but a short time since it was not even suspected and in spite of the fact that many of the ablest investigators have undertaken the task, practically the whole of the evidence upon which it rests is clinical. No pathologist has proved the existence of a germ to the satisfaction of the rest; all the ordinary methods of staining and cultivation have failed to give a convincing result; and no inoculation experiments have succeeded with the exception of a few upon monkeys. Even in the interpretation of the clinical phenomena there are very great difficulties. Recent investigations, however, with regard to the mode of the action of pathogenic germs, and especially the substances formed by them during their growth, have extended our knowledge so far that, although argument from analogy requires to be carefully employed (if there is a germ the conditions under which it thrives are very stringent and possibly it does not belong to the same order as other pathogenic organisms), it may not be unprofitable to consider how far the present standpoint is justified.

1. *The chancre.*—The first difficulty is the existence of a chancre; there is nothing exactly like it in any other microbic disease. It is not the presence of peculiar anatomical features, the intense induration of the base for example, and the sharp definition of the edges; these are easily accounted for by the

specific character of the inflammation, the anatomical struct-
ure of the seat of infection, the amount and direction of the
connective tissue fibres it contains, and the depth to which the
infection is carried at the time of the inoculation; and even if
this were not the case there is so far nothing exceptional, for
the initial lesions caused by the inoculation of other patho-
genic organisms are often distinctive; the peculiar feature is
that, with rare exceptions, it can never be produced again. A
malignant pustule or a tubercular nodule can develop at any
time in any patient suffering from anthrax or tuberculosis no
matter what may be the condition of the original point of in-
oculation; chancre, on the other hand, if the specific indura-
tion has once appeared and the disease is still recent, never
can (I omit for the present cases of relapsing and recurrent
chancre, and those in which reinfection has taken place after
some years; they are not as rare as is usually believed, but
they are not sufficiently common to invalidate the general ar-
gument). A chancre occurs but once; there is no other syphi-
litic lesion like it; it is never reproduced in the course of the
disease; it is never seen among the eruptions of the secondary
or tertiary period; and after the induration has once devel-
oped, it cannot be produced again even by a fresh inocula-
tion.

This is not due to any alteration the germ has undergone,
for inoculation from an entirely fresh source is equally futile;
the change is in the tissues, they no longer react in the way
they did before the chancre was formed. How this effect is
produced is a different matter. Probably it is the result of the
action of some chemical substance formed during the growth
of the germ, for it affects the whole body, not the locality
alone, and its influence is apparent almost from the first day.
If inoculation is tried before the induration has developed,
during the period that elapses between the original infection
and the local manifestation, the incubation period is so short-
ened that the two chancres attain maturity together.

In other words, tissues that are healthy possess some power
of resistance against the syphilitic microbe; there is a long
incubation period; growth at first is slow, and even when the
germ has gained the lymph stream its extension for some time

is not rapid. Almost, however, from the date of infection the presence of the germ has so great an influence on the tissues that if inoculation is performed a second time either the period of incubation is shortened or the power of local reaction lost altogether.

This cannot be called immunity. There is such a thing as immunity from syphilis, possibly due also to the influence of a chemical product of the germ, but it is different from this. A person cannot be said to be protected from syphilis while suffering from a secondary eruption. Nor can it be called immunity from chancre except in the sense that a person suffering from early syphilis is incapable of developing one.

After a time this peculiar condition subsides; the tissues regain their original power and infection follows its usual course. In some instances only a local sore is formed with more or less of the characteristic induration; in others secondaries make their appearance after the usual time, and occasionally tertiaries as well.

At what period the organism first enters the blood stream is uncertain. As, however, excision or cauterization of the seat of infection almost always fails after the third day, it seems probable that constitutional infection precedes induration. In this case the chancre must be looked upon as a kind of nursery for the germ in the same way that a malignant pustule is for the bacillus of anthrax—the microbe in either case gaining the blood and circulating with it while producing its earliest local changes at the site of the original infection. Unhappily the comparison is incomplete, for while in anthrax destruction of the chief source of the germ materially assists the tissues in dealing with the rest, there is no evidence of any such thing in syphilis.

2. *The secondary period.*—In this there is less difficulty; the organisms continue to accumulate in the blood and the poison to increase in quantity until the well known series of symptoms breaks out. In most cases they are transient; the cellular exudation is small in quantity; the anæmia not serious, and the changes even in the bones chiefly vascular, subsiding readily under treatment. In a few the effects are more grave; the exudation is abundant, as in the tertiary period; the loss

of health very serious, and suppuration and even phagedena may occur. Neither of these is part of the syphilitic process; they may make their appearance at any time, but they are complications due to other kinds of microbes, which find an appropriate soil in the badly nourished and enfeebled tissues of syphilitic patients. Exceptional cases of this nature must be assigned to individual idiosyncrasy—similar occurrences are well known in connection with other specific disorders— for although neglect of treatment or its abuse (there is reason to think that the reckless administration of mercury is especially injurious) may assist, neither is a sufficient explanation by itself.

During the whole of this stage the specific microbe is present in the blood and in the secretion from the cutaneous lesions; they are both intensely infective; but whether the eruptions are the direct product of the germs or of the poisonous subtsances given off by them is uncertain.

3. *The latent period*.—After the secondary symptoms have subsided, the course of the disease is less uniform, and the difficulty of finding an explanation for the clinical phenomena increases. The most striking features are the development of personal immunity and the loss of the power of infection by contact, although (in untreated cases at any rate) that of hereditary transmission persists for many years.

The first of these is, in my opinion, very much overrated. I have known many cases of second infection, a typical one within two years and a half, but immunity, more or less, does exist, and is not to be explained away by saying the patient is syphilitic already, unless that is to say, a similar explanation is allowed for the well known period of immunity after variola, scarlet fever and other specific fevers. Arguing from analogy, it must be the result of some change in the nutrition of the tissues affected by the germ, whether it is the addition of some potent material poured into the blood during the secondary stage, or the exhaustion of something that . is essential to the development of the organism. Of the two the former appears the more probable, as it helps to explain the curious protection so often acquired by the mother in cases of heredi-

tary syphilis, and agrees better with what is known of other microbic diseases.

The other peculiarity, the loss of the power of infection by contact, while that of hereditary transmission still persists, can only be explained on the hypothesis that the germ, by continuing to live under the same conditions, has lost some of its original power. The secretion from all secondary eruptions is intensely contagious; that from tertiary ones is not. How long it may be before the power is lost is not known, but there is reason to think that even in cases that are not treated, it dies out by the end of the second year. On the other hand, it is by no means unusual for six or seven miscarriages to occur consecutively, and then for the children who do survive to show signs of the disease, even if ten years have passed. The organism, therefore, is not dead; it has merely lost the power of direct contagion, for if transplanted with the ova or spermatozoa, it springs up into activity again and resumes all its old virulence. The difference between the two phases of its existence is as striking as the alternation of generations in plants and animals.

4. *Hereditary syphilis.*—The phenomena attending inheritance are especially interesting. As the disease is capable of absolutely indefinite multiplication, there can be no doubt that the agent is a living organism. Further it is known that it can be conveyed either through the placenta (as in the case of syphilis acquired late in pregnancy), or through the ova or spermatozoa; but it is equally certain that the disease is very considerably modified. In acquired syphilis the incubation period and the earlier symptoms follow a definite course; in the hereditary form they are much more variable. The lesions may be of the gravest description and prove fatal long before birth, or very mild and give no evidence of their existence for many weeks. In the earlier pregnancies the disease is usually severe; in the latter ones, much milder. In the case of twins one may suffer exceedingly badly, the other but little. In short, although the germ must be the same, its action is widely modified by the conditions under which it is living.

The chief interest is in the law first enunciated by Colles and abundantly verified since. It is one of the best estab-

lished facts in syphilis that a syphilitic child, begotten of a syphilitic father, may be born of a mother who not only shows no sign of the disease herself at the time (tertiaries may make their appearance later), but is apparently incapable of being infected. In other words, the mother is protected without there being any evidence that she is suffering from the disease; and as tertiary affections, although they may occur, are by no means the rule, in a very large proportion of cases the protection is absolute. Arguing from the analogy of other diseases known to be caused by micro-organisms, it has been suggested by Finger and others, that this peculiar immunity is best accounted for by the difference in the relations that exist between the germ and the chemical products it forms during its growth. The specific microbe passes into the ovum and develops in the fœtus; some chemical virus is produced (the same, perhaps, that is the cause of the period of immunity following the secondary stage in acquired syphilis) and this being carried from the fœtus to the mother through the placenta, protects her so thoroughly that infection from her own child after birth is unknown.

If this view is correct, the specific micro-organism in acquired syphilis works its effect before immunity can be established; in the hereditary form, in which the germ is developing under very peculiar conditions, immunity, so far as the mother is concerned, is acquired first.

The chief difficulty is to account for the fœtus frequently suffering severely while the mother escapes. One suggestion is that the organism itself never passes from one to the other (except in those cases in which secondary symptoms break out in the mother); and that consequently only vague general phenomena follow, such as anæmia and loss of health and strength, without any of the characteristic effects. The occasional outbreak of tertiary disorders must then be accounted for on the ground that the germ is not essential to their production. As, however, the organism can pass over as easily as the germs of any other specific disorder, and as it actually does so in a certain proportion of instances, it seems upon the whole more reasonable to suppose that this usually takes place; and that the mother escapes while the fœtus does not,

either because the chemical virus upon which immunity depends passes over more easily than the germ (in the same way that the poison which prevents the development of a chancre spreads over the body long before the germ is able to cause the outbreak of secondaries); or else that, while it can protect the mother thoroughly from secondary eruptions in the fœtus, it is only capable of delaying the outbreak, without preventing it, and prolonging the incubation period.

5. *The outbreak of tertiaries and the relation they bear to other symptoms.*—Tertiary symptoms only occur in a very small proportion of cases, even when treatment is neglected, and they differ from all others in many important particulars. They vary immensely in the date of their origin; they may begin almost at once, or there may be a long interval of perfect health; they have no tendency to get well of themselves; they respond differently to the action of drugs; and although hereditary transmissions may occur during this period, it is not invariable, and probably depends upon the state of health of the individual at the time.

It is generally held that although the later lesions are a consequence of the disease, they are not the direct effect of the germ; that the cause is some peculiar state of nutrition in virtue of which the tissues no longer react to irritants in the ordinary way, but develop gummata instead. This hypothesis, although much may be said in its favor, can scarcely be regarded as satisfactory; it merely states the facts over again in other words; it suggests no reasons for the rarity with which tertiary lesions occur, or for the length of time, passed in many cases in perfect health, that may elapse without a sign of any thing wrong; it presupposes the existence of some irritant other than the syphilitic germ, whenever a tertiary lesion breaks out (unless it is held that the diathesis which has been dormant so many years has at length become sufficient of itself); and it implies that the growth and persistence of gummata can be accounted for merely by a condition of malnutrition.

On the other hand, there are good reasons for believing that in many cases at any rate the germ is present in the tissues and still alive, although, as happens sometimes with tubercle,

it may be latent and require some additional irritant to wake
it into life again.   Putting aside those instances in which ter-
tiary manifestations occur early in the course of the disease,
before the power of contagion is lost, the facts of hereditary
transmission are sufficient.   The germ, it is true, is greatly
modified; it has lost some of its original properties; it acts
now as a local irritant, and the tissue changes it causes pre-
dominate greatly over the vascular ones ; but if by continuing
to live under the same conditions, it can lose its power of con-
tagion without altering its nature, there is no great degree of
improbability in the supposition that in the same way it may
lose the power of affecting the system generally while retain-
ing that of acting local irritant.   There are, it is true, one or
two points that require explanation if this view is adopted.
One is the possibility of reinfection.   The period of protec-
tion is probably much shorter than is usually believed and a
chancre followed by the ordinary symptoms may occasionally
be seen side by side with tertiary lesions from some anteced-
ent infection.   This, however, does not prove that the original
virus is dead ; it merely shows that protection is exhausted
and susceptibility regained; the specific germ may be there
still, unable to cause a general disorder, though it is capable
of giving rise to local trouble.

Another has been already mentioned in discussing Finger's
hypothesis as to the cause of the immunity acquired by the
mother in cases of hereditary transmission.   Tertiary symp-
toms may undoubtedly occur in the mother without there ever
having been a chancre or a secondary eruption. This he considers
sufficient evidence to prove that they are due to some chemical
poison transmitted from the fœtus to the mother in utero, and
not to the germ itself.   Now, the immunity is a fact, and the
occasional occurrence of tertiaries under these conditions
must be admitted, but these premises do not by any means en-
tail the conclusion he draws.   It is quite as reasonable to sup-
pose that at the time that the chemical virus is carried from
the fœtus to the mother to confer immunity on her, the germ
which undoubtedly exists in the blood of the fœtus and un-
doubtedly possesses the power of passing over, may do so too,
though it is unable to manifest its influence, owing to the de-

gree of protection already acquired. Then, years later, when the latter has died out, the germ that has remained latent in the tissues may be suddenly roused into activity again and, as in the case of the acquired disease give rise to local symptoms.

6. *The later effects of hereditary syphilis are not easily explained.*—In their general aspects they resemble the ordinary symptoms of the tertiary period and probably if these are dependent upon the local action of the specific micro organism they are dependent upon it too ; but there are important differences. Drugs that usually cure tertiary lesions at once have but little influence on many of these, so that if the germ is still living, it must have become still further modified. Many of them are not met with in the acquired form. They nearly always begin, not at irregular intervals, but at one definite time, the commencement of puberty ; before this it is exceptional to meet with them ; and if this is passed without a sign, they rarely begin afterward. In several cases the development changes that take place at puberty are very much delayed, and often are never thoroughly carried out ; the stature remains low ; the face retains the appearance of childhood ; the pelvis and the figure in the female do not develop ; and at twenty the boy or girl retains the appearance of thirteen or fourteen. It seems reasonable to connect these occurrences with each other, and to believe that the sudden outbreak is in so.ne way dependent upon the immense changes that are inaugurated at this time of life ; but in the present state of our knowledge it is impossible to do more than associate them together, whether it is thought that the germ is still alive, or that every thing can be accounted for by the profound disorder of nutrition it has left behind it.

7. *Conclusion.*—It must be admitted that a great deal of the preceding is speculative, and that argument from analogy is especially dangerous in the case of syphilis, so little is known with regard to the effect of constitutional peculiarities upon its course. That the original cause is some form of living organism is morally certain ; and, if this is admitted, it seems more reasonable to suppose that the later lesions are due to some modification the germ has undergone (it is certainly capable of very extensive ones) rather than to a diathesis which in the

majority of instances only becomes manifest years after the cause has departed. The facts of acquired syphilis agree as well with one theory as the other; those of the hereditary form distinctly favor the former. The most striking deduction from the germ theory is the explanation it offers for Colles' law; and though there is much yet that requires elucidation, especially as regards chancre and late hereditary lesions, there is no doubt that the assumption of the formation of some chemical virus, which may either cause the same symptoms (like tetanin for example), or confer immunity according to the particular conditions under which it is acting, offers the most reasonable explanation for the facts, so far as they are known at present.

A NEW METHOD OF DOING JOBERT'S OPERATION.

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OUR technique and diagnosis in surgical diseases of the intestines is yet in its imperfect infancy. I would simply ask that the effort to improve this field be received with patience, for the significance of the intestines in abdominal surgery is important, when we consider that a little over 1 % of all laparotomies die from intestinal obstruction, due to the operation. I was really gratified at the warm reception with which so many able surgeons received my effort to extend the utility of intestinal surgery, by the introduction of the rawhide or segmented rubber plate. Surgeons welcomed the plates because they were cheap and accessible, and they predicted their usefulness in intestinal anastomoses from the simple fact that the plates had stood the test of dozens of successful living experiments. I hope the plates will serve as a base for further progress, for they possess the utility of being pressed into man's service at any moment. This will increase the opportunity of their use. In the present modification of Jobert's operation it is with the hope of improving the safety of the operation. The danger of Jobert's operation proved very great in our experiments, and of course the main danger lies in the occurrence of fæcal fistula at the points of the invagination sutures. The modifications or improvements I have to offer on Jobert's operation are: First, the avoidance of the invagination sutures, and second, the use of a rubber tube to keep the bowel from invagination at the seat of operation; and third, to keep the lumen of the bowel patent at the same

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point. I shall only speak from actual facts in the experiments. The invagination in Jobert's operation produced fæcal fistula (with both catgut and linen sutures), and also caused death. The idea that invagination of the intestine will continue to a point of obstruction, from simply turning in a small part of its end, to do the operation, I never saw recorded, but it will actually happen, and it killed several of our dogs. Hence to avoid this disaster, an operation should only turn in about one-half to three-fourths of an inch of the end of the gut. The muscles from that short bit of gut can not get purchase power to progress. In closing a gut end, only one-half an inch should be turned in, and then sutured with a few continuous Lembert sutures. The addition of a rubber tube, I think, increases the safety of the operation very much.

The rubber tube certainly aids in preventing subsequent invagination at the seat of the operation, and the longest part of the tube should be above (three-fourths) the point of operation. The tube keeps the gut lumen patent. It holds the two serous surfaces, which are to unite, in constant approximation. It prevents the gut from wrinkling and allowing fæcal extravasation. It produces the great essential of healing, which is mechanical and physiological rest, which, alone, induces appropriate cell proliferation. The tube is held in its position by one or two sutures passed through the edge of the proximal intestinal end and through the tube. One can determine how long the tube will remain in position by the amount of intestinal wall, the suture, which holds the tube, embraces; or on the kind of suture (catgut or silk or linen).

The main steps of the operation are the severing of the gut and the determination of the proximal and distal bowel, or the direction of the fæcal current. The serous surface of the distal gut is scarified for one-half inch and invaginated to the same extent. Now, a rubber tube which snugly fits the gut lumen is pushed up into the proximal gut and stitched there. (I generally used a tube five inches long, placing about three inches above and two inches below the point of operation.) An inch of the serous surface of the end of the proximal gut is scarified. Then the proximal gut is inserted into the invaginated distal bowel for one inch. , A circular row of Lembert

sutures are applied at the junction of the serous surface of the proximal and distal bowel. This same surface for one-half inch adjacent to the sutures is well scarified, and an omental graft wrapped around and sutured in position. The omentum is carefully respread over the intestines, and the belly closed.

The following experiments will explain themselves:

EXPERIMENT No 149.—Dog, female, weight, 25 lbs. Abdomen shaved and opened by 3 inch incision (animal chloroformed). The first point was to find the cæcum, which served as a standard to determine the direction of the gut (or fæcal current). The ileum was completely severed. An inch of the serous surface of the distal bowel end was scarified and invaginated for one inch, and rubber tube ($\frac{1}{4}$ inch by $2\frac{1}{2}$ long) was stitched into the proximal gut. An inch of the serous surface of the proximal gut end was scarified. The proximal bowel was inserted into the distal and at the junction of the serous surfaces of the proximal and distal guts 10 circular Lembert sutures were applied. The surfaces of the bowel adjacent to the sutures was well scarified and an omental graft applied and held in position by sutures. Abdomen closed.

The dog died thirty-six hours after the operation. The autopsy showed that the distal bowel had continued to invaginate until it had passed beyond the rubber tube. Death in such cases generally arrives from shock and gangrene. The rubber tube was not long enough to prevent invagination.

EXPERIMENT No. 152.—Dog, male, weight 15 lbs. Animal chloroformed, belly shaved and opened by median incision of 3 inches. The cæcum was found and the gut's direction determined. The bowel was entirely severed. The distal gut was scarified for $\frac{3}{4}$ inch and invaginated for that distance. A rubber tube 5 inches long, $\frac{1}{4}$ inch in diameter was sutured into the proximal gut end so that $3\frac{1}{2}$ inches would project on the proximal side of the operation. An inch of the serous surface of the proximal bowel end was scarified and the proximal bowel end was inserted into the distal. Circular suturing by Lembert's method was done at the junction of the serous surface of the proximal and distal bowels. The serous surface for $\frac{1}{2}$ inch adjacent to Lembert's sutures was scarified and an omental graft applied around the operated parts and held in position by sutures.

The dog made an excellent recovery. He ate, drank and played. He was killed twenty days after the operation. The autopsy demons-

trated that the abdominal viscera were quite healthy with a few local adhesions from the operation. The graft had grown firm and solid. A few Lembert sutures still remained. The dog was fattening. The rubber tube had disappeared. The gut lumen had narrowed probably one-fifth of its original size.

Other work was done, but probably sufficient has been given to illustrate the method and technique of the operation. With a dog having a small gut it is difficult and dangerous to do this operation, as gangrene may follow (say of a dog under 12 pounds). But with a good sized gut it seems to me that this ought to be as safe as any intestinal operation of its kind. It should be much safer than Jobert's. The avoidance of the invagination sutures is a great step in advance. The addition of the rubber tube and scarification, with an omental graft, add infinitely to the chance of recovery. Of course, Jobert's operation, and this modification of it, is only to get something better than the dangerous circular enterorrhaphy. Circular enterorrhaphy was found, in the experiments, to show very clearly the following dangers, which I have previously noted, but repeat them, in order that attention may be directed more to them:

1. Circular enterorrhaphy paralyzes the gut at the seat of operation, and hence does not so readily relieve the fæcal obstruction, which is the immediate object of surgical interference.

2. Fæcal fistula is apt to arise at the point of operation.

3. Gangrene or sloughing may arise from the pressure on the tissue of numerous sutures.

4. The lumen of each gut may not be of the same size, and thus present difficulty in union.

5. The pathological changes in the bowel, due to obstruction, offer impediments. The gut may be stretched so thin that a needle can not be passed between the muscular layer and mucous layer without danger of penetrating the mucous membrane and causing fæcal fistula. Also the stretching of the bowel may seriously impair the power of healing. The trauma has destroyed the vascular and nervous integrity of the tissues of the gut wall.

6. Circular stricture may and did follow the operations. Some of the strictures were so severe that both fæces and gas were actually obstructed, and many autopsies showed dangerous narrowing of the gut lumen. Mechanical or even physiological obstruction was liable to occur at almost any moment in such narrowed bowels.

7. The long time required to do a circular enterorrhaphy militates against the chances of recovery. Of all surgery in the world, intestinal surgery should be rapid and skilful. At first it required us to work about an hour to do a circular enterorrhaphy. Acquired dexterity reduced the time to 40 or 30 minutes. We used in a large dog, 25 to 35 interrupted Czerny-Lembert sutures at first. Afterward we made Czerny's suture a continuous suture, which can be done in a couple of minutes. Finally we tried making Lembert's sutures continuous for two, three or four stitches. This worked well and saved time. So that three to five interruptions of Lembert sutures completed the circle around the gut. In this way a circular enterorrhaphy could be completed in less than half an hour. I emphatically oppose doing a circular enterorrhaphy with a continuous Lembert's suture. This was carefully tried, and the worst strictures of all resulted, and not only that, but the thread gradually fell into the gut lumen, and its end dangled for days and even weeks there before it became entirely set free. This long thread will certainly be a dangerous source of infection, as part remains in the gut lumen and part in the gut wall. Infective fluids can go along the thread by mere capillary attraction, not to speak of the wider fæcal fistula it may create.

It should be well borne in mind that about 40 minutes' exposure of the viscera of *some* dogs seemed sufficient to kill them.

Some miscellaneous remarks may suggest useful things. The rubber tube should be made of soft thin walls, and the operator should be positive that it does not press too hard against the gut wall, or gangrene will result. The omentum should be re-spread over the intestines *always*. The operated point should be anchored to the abdominal wall by a thread. The thread should be passed through a small hole in the omen-

tum and protrude at the abdominal incision. This anchoring will enable one to reopen the abdomen and easily find the old operated parts. It will enable one frequently to reopen with out going into the general peritoneal cavity, as adhesions have circumscribed the operated part and excluded it from the general peritoneal cavity. Hence it can be washed out with no disturbance of the general abdominal cavity. The direction of the gut must be determined with certainty, then a red ribbon can be tied around the proximal, and another colored around the distal gut, and the whole intestines, except that part operated on, can be replaced in the abdomen.

The omental graft may be applied from the edge of the omentum without severing it. But it is likely to produce less subsequent evil results if *torn* (not cut) from the edges of the omentum. This will allow an uninterrupted re-spreading of the omentum, just 'before closing the abdomen. Anchorage insures more safety in case of fæcal fistula, as then the fistula will be directed toward the surface in more manageable regions. Catgut proved in experiments of intestinal work *dangerous*. I used almost entirely linen thread, soaked in alcohol. The threads were (*a*) in the great majority of cases thrown into the gut lumen, (*b*) encapsulated and (*c*) absorbed. Threads would occasionally be found partly in the gut lumen and partly in the gut wall *two months* after the operation. The mesentery of the invaginated gut or distal gut should be cut fairly close to the gut wall, as far as it is invaginated. It should not be torn off, as no blood vessels will then be left to nourish it, and gangrene may result. The mesentery of the proximal gut should be cut away as far as it is to be inserted into the distal gut. Both stumps of the mesentery should be scarified with the needle point, as the scarified surface does not bleed so readily, and heals quicker than a clean cut surface. I feel quite certain that hæmorrhagic layers of blood did prevent early healing in some cases. Again, peritoneal plastic exudates are entirely uncertain as to time. The exudate may appear in a few hours, or be delayed some 24 hours. Therefore, the value of the rubber tube is very apparent; it insures continuous coaptation. The approximation of the two bowel sur-

faces to be healed is constant until exudation has had suffi-cient time to appear and cement the surfaces.

The necessary mechanical and physiological rest required for definite healing and cell proliferation must be forced by fixation on a bowel which takes the liberty at any moment to caper through a peristalsis and break up any new adhesions. The long rubber tube does this excellently.

I wish to thank Dr. C. S. Miller, of the city, who kindly aided and shared in the operations.

THE OPERATIVE TREATMENT OF HEAD INJURIES[1].

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THE operative treatment of head injuries, particularly at this time when so much is being done in the way of brain surgery makes the subject, worthy of our careful consideration.

Valuable pathological facts have been learned in many of the operative brain cases; in some, showing the lesion to be due directly to an old head injury, while in others, indirectly the result of such an injury. The head injuries which, in my judgment, demand operative treatment, may be classified as follows:

1. Injuries of the scalp.
2. Injuries of the cranium.
3. Injuries of the contents of the cranium.

Of the first classification I will simply say, that the treatment of these injuries does not differ from the treatment of similar conditions in the soft parts elsewhere with the exception of contusions, in the management of which I make a wide difference, to this effect, when the contusion is accompanied by brain symptoms I expose the part of the skull underlying it by an incision. If there is a depressed fracture I trephine; if there is a fissured fracture with hæmorrhage through the line or lines of fracture I also trephine for reasons which I will mention later.

[1] Read before the Berks County Medical Association, January 13, 1891.

I have had ample opportunity in my hospital practice to demonstrate why I take this position in the treatment of contusion of the scalp with brain symptoms. In the large majority of these cases it is impossible to differentiate between simple contusion and contusion associated with depressed fracture, yet the benefit of the doubt is so important to the patient, both as to the immediate and the remote good to be derived from positively settling the question without delay, that I am fully convinced the only sure way is the one which I both practice and advise. Again, in fissured or stellate fracture with swelling, fullness or contusion of the scalp, how is it possible to tell whether the extravasation into the scalp tissue is the result of rupture of the scalp vessels or of leakage from an intra-cranial hæmorrhage, through the fissure or fissures into the areolar tissue layer of the scalp, thus simulating a contusion so closely as to make it impossible to determine the condition in any other way? I grant that by an incision if there be a fracture present, it is made compound, but with our present manner of operating this does not offer a single complication much less an objection.

Compare the old manner of treating these conditions with the relief of a depressed fragment or fragments of bone, the removal of an intra-cranial clot or may be the arrest of an intra-cranial hæmorrhage and, are you not at once convinced my stand is a rational and not a fanciful one.

I have stated I have demonstrated this to be the correct treatment. Naturally the question will be asked, how have I demonstrated it. By making post-mortem examinations in fatal cases, I either did not or was refused the privilege of ante-mortem examination in. In my earlier career as a hospital surgeon, following the instruction I received as a student, I regarded cases of the kind, about which I am speaking, as unjustifiable for operation, believing them to be contusions complicated by concussion or compression. Later, when more attention was being given to cerebral localization I determined it was high time to take nothing for granted, but in the cases terminating fatally, where possible, to learn the actual cause of death by post-mortem examination. This I have rigidly done in a number of cases which I have had under my care in the

hospitals to which I am one of the visiting surgeons. In many of the cases I found either a depressed fracture, a fissured fracture alone, or a fissured fracture with one or more of the varieties of intra cranial hæmorrhage to which I will refer later and therefore I believe I have good reasons for formulating a rule to be observed in the treatment of these cases to which I now strictly adhere.

The diagnosis of laceration and contusion of the brain substance in fatal cases where an opportunity of inspecting the brain before or after death has not offered, will not stand the scientific test.

Having operated upon a number of old fractures of the skull for epilepsy, brain cyst, arterio-venous aneurism, etc., I am still further convinced that a positive diagnosis should be made immediatly after the receipt of the injury.

Non recognition of a depressed fracture owing to the presence of a contusion of the scalp may arise in a medico-legal point of view, when the patient is afterward the subject of traumatic epilepsy, mental defect, etc.

Injuries of the cranium.—The operative treatment of fracture of the skull is practically embraced under one operation, that of trephining; The opinions of different operators are still at variance as to what circumstances render the operation justifiable in certain cases. I will not attempt to give the different views of the authorities upon this subject but, content myself by discussing it from the standpoint I believe to be the safest for the patient, that which I would want done in the case of myself were I so unfortunate as to meet with this accident.

The following list embraces the fractures of the skull in which I advise trephining.

1. Simple depressed fracture with or without brain symptoms.

2. Compound depressed fracture with or without brain symptoms.

3. Impacted fracture, simple or compound, with or without brain symptoms.

4. Comminuted fracture, simple or compound with or without brain symptoms.

5. Compound fissured fracture with depression of bone without brain symptoms.

6. Compound fissured fracture with depression of bone with brain symptoms.

7. Compound fissured fractures without depression of bone and without brain symptoms in which there is bleeding through the fissure or fissures.

8. All punctured, incised and gunshot fractures.

In punctured fractures of the cribiform plate of the ethmoid bone the best point to apply the trephine is to the roof of the orbit at the inner angle, thus opening the most dependent part of the anterior cerebral fossa, thereby favoring drainage, at the same time making it possible to render the parts more thoroughly aseptic; two important indications are to be fulfilled in this class of injuries.

The rationale of trephining in any case of depressed fracture, simple or compound, is that the patient is much less exposed to the risk of becoming the subject of epilepsy, mental defect, persistent loss of memory, general nervous deterioration, to say nothing of the immediate danger of pachymeningitis (external or internal) being excited by the depressed fragment.

I have spoken of the rationale of trephining depressed fractures, my reasons for operating here hold good also for impacted and comminuted fractures, as it is scarcely to be expected that either of the latter varieties can exist without some depression.

My argument for operating in compound fissured fractures without depression of bone, but with brain symptoms, is to determine definitely whether or not they are caused by the presence of a blood clot.

I admit that in the majority of fissured fractures, simple or compound, the fracture extends to and involves the base of cranium, but this I do not regard as a contraindication to exploration, as the association of the two conditions, namely, the presence of the intra-cranial hæmorrhage, and a fracture involving the base of the skull, make the case all the more urgent and less likely to recover if left alone.

All fractures of the base of the cranium, when treated anti-

septically, are not necessarily fatal, as has been shown by Prof. Dennis; therefore, if such a fracture be complicated by the presence of an intra-cranial hæmorrhage conveniently situated for operation, why not here, as in compound fracture elsewhere, remove at once, as far as possible, the complication? With the full benefit of antiseptic surgery this, like many other operations, is attended by little risk in itself, granting, of course, one of the large sinuses is not opened.

If one of the sinuses be accidentally opened in trephining, and the opening be a small one, the bleeding can be readily controlled by grasping the wall of the sinus upon either side of the opening with a hæmostatic forcep, which latter may be left in the wound for two or more days; this is safer than to attempt to control the hæmorrhage by applying a ligature. Should the forceps be in the way of the operator, plug the opening with antiseptic gauze, the latter being always preferable when the opening is large. If we are careful this accident can usually be avoided.

Injuries of the contents of the cranium.—Injuries of the contents of the cranium include intra-cranial hæmorrhage and laceration of the brain and its membranes. The treatment of the latter consists chiefly in the removal of foreign bodies, if they be present, rendering the parts thoroughly aseptic, and suturing the dura mater. The treatment of intra-cranial hæmorrhage calls for trephining and removal of the clot. The varieties of intra-cranial hæmorrhage offering the best outlook for good results from operation are the epi (extra) dural and the sub-dural. Intra-cranial hæmorrhage embraces in all four varieties.

1. Where the blood finds its way between the inner wall of the cranium and dura mater.

2. Where it finds its way into the sub-dural space.

3. Where it finds its way into the meshes of the pia-mater.

4. Where it escapes into the substance of the brain or into the ventricles.

Erichsen gives the third variety as the most common form of intra-cranial hæmorrhage, while Prescott Hewett gives the second variety as the most common. (The cases I here report in which I trephined were of the extra and sub-dural varieties).

When blood is poured out between the dura mater and the bone, in case of fracture, the vessel usually torn is the middle meningeal artery or its branches. Mr. Jacobson has shown that the branches of this artery are more frequently torn at the point where it crosses the inferior angle of the parietal bone. The reasons for this are :

1. The bone at the site of the groove for the artery is very thin.

2. The vessel is so frequently buried in the bone that fracture without laceration of the vessel is hardly possible.

3. This part of the skull is especially liable to be broken.

It has been shown that the artery may be ruptured by force sufficient to occasion detachment of the dura mater, but not great enough to fracture the skull. Next to the middle meningeal, the most frequent source of extra-dural hæmorrhage is the lateral sinus. In referring to the attachment of the dura mater to the cranium, we find that it is intimately adherent to the bones forming the base of the skull; therefore, this variety of hæmorrhage in this situation is barely possible. Over the vault of the cranium its attachments are comparatively loose, except along the lines of the sutures. Sir C. Bell has shown that the dura mater of the vault may be separated from the bone by the vibration produced by a blow. Strike the skull of the subject with a heavy mallet ; on dissecting you find the dura mater separated from the skull at the point struck. Repeat the experiment on another subject and inject the head minutely with size injection, and you will find a clot of injection lying between the skull and the dura mater at the part struck and having an exact resemblance to the coagulum found after violent blows on the head. Tillaux has demonstrated that the adhesions between the dura mater and the bone are particularly weak in the temporal fossa, the most usual site of meningeal hæmorrhage.

In the diagnosis of extra-dural hæmorrhage the following points are to observed :

Mental condition.—May be normal or there may be cerebral irritation. Unconsciousness complete or incomplete or coma.

Condition of the pupils.—May both respond to light normally. May both be dilated and show no response ; or one

may be widely dilated and the other normal. When the dilated pupil corresponds to the injured side, it is caused, as pointed out by Hutchinson, by the pressure of a large clot, extending deeply down into the base of the skull on the cavernous sinus, leading to fullness of the vessels with protrusion of the eyeball and dilatation of the pupil. It is also accounted for by the compression of the oculo-motor nerve by the clot.

Respiration.—May have stertorous breathing, Cheyne-Stokes respiration or cyanosis.

Pulse.—Little changed, or rapid and feeble, depending largely on the severity of the concussion; or slow and full, depending upon the severity of the compression.

Limbs.—May present any of the following conditions: Hemiplegia, on the same side as the injury, indicating hæmorrhage on the opposite side; monoplegia, paralysis, twitching, convulsions, rigidity (spastic).

Scalp.—Presence of contusion, or bogginess due to the injury; the latter also due to leakage from within the cranium through a fissured fracture.

The stages presented by a typical case of extra-dural hæmorrhage are three:

1. Complete or partial unconsciousness, the result of the concussion or shock, caused by the fall or blow, as the case may be.

2. Consciousness or lucidity. This stage may vary in length from a few minutes to several hours. "Is present in about one-half of the cases," says Jacobson.

A very large hæmorrhage may produce compression at once, as I have observed, verifying my observation by postmortem examination. Compression may also come on immediately, caused by co-existing depression of bone, injury to the brain, and alcoholism.

3. Compression.

CASE I.—Traumatic aphasia caused by pistol shot wound of the left temporal region with fracture of the internal table of the skull and extra dural clot at a point two inches behind the external angular process of the frontal bone and two inches above the zygomatic arch; trephined; clot removed; anterior branch of the middle meningeal artery tied; perfect recovery.

CASE II.—Lacerated wound of scalp immediately in front of left parietal eminence.

Patient was conscious for a short period after the occurrence of the accident; this was followed by cerebral irritation with twitching of right face, arm and leg. Coma supervened with general convulsions commencing on right side. Skull intact. Trephined. Large extra dural clot involving the region of the posterior ends of the second and third frontal convolutions removed, leaving a space between the skull and the dura mater which held four ounces of a 1:2000 solution of bichloride of mercury. Death two hours after operation.

Autopsy twelve hours after death, brain and cranial cavity alone examined. Upon removal of the calvarium the surface of the dura mater was found normal, except at the point of separation already referred to. Brain removed. Dura mater lining sides and base of skull removed, when was seen a fissured fracture starting in the left parietal bone immediately below trephine opening and extending into the floor of the middle cerebral fossa. Examination of the brain showed it to be perfectly normal except at three points on the basilar aspect of the left temporo-sphenoidal lobe, which were contusions involving only the gray matter, as shown by making sections of the brain. No further evidence of intra-cranial hæmorrhage or other lesion.

CASE III.—Contusion of scalp over vertex and whole of the left side. Lacerated wound of right ear at the junction of the concha with the scalp. Complete unconsciousness; pupils responded to light; conjunctival reflexes normal. A short period after the accident regained consciousness lasting about five minutes, which was followed by a general epileptiform convulsion lasting one minute. Convulsion commenced on right side. This was followed by a second convulsion of the same character. Right arm and leg spastic. Left arm and leg parietic. Trephined over the anterior branch of the left middle meningeal artery. Extensive sub-aponeurotic hæmorrhage. Fissured fracture Extra dural hæmorrhage, both the posterior branches of the middle meningeal artery torn. Clot removed and vessels tied.

CASE IV.—Swelling of the right side of scalp with sub-conjunctival ecchymosis of right eye. Scalp tumor incised, finding fracture of the right parietal bone. Trephined. Extra dural clot. Meningeal vessels tied. Death two and one-half hours after operation. No autopsy.

CASE V.—Compound depressed fracture of the skull in left temporal region. Trephined. Bleeding meningeal vessels tied. The fracture was plainly seen extending into the petrous portion of the temporal bone. Death four hours after operation. No autopsy.

CASE VI.—Unconsciousness. No paralysis, patient able to swallow.

Small scalp wound over the occipital region. No operation. Death in forty-eight hours.

Autopsy, fissured fracture of the occipital bone extending from the external occipital protuberance into the foramen magnum. Extensive sub-dural hæmorrhage.

CASE VII.—Struck by a train. Unconscious. Stertorous breathing. Right hemiplegia. Large scalp wounds. Depressed fracture over left parietal bone. Trephined and fragments of bone removed one-half hour after operation; consciousness returned and uninterrupted recovery followed.

CASE VIII.—Swelling of scalp over left temporal bone which increased in size. Unconsciousness. No paralysis. Operation refused. Death in thirty six hours.

Autopsy twelve hours after death. Fracture of the left temporal bone extending into middle fossa of skull. Large extra-dural clot. Brain normal.

CASE IX.—Small scalp wound over vertex with a bulging tumor in the left temporal region. Ecchymosis of the left upper eyelid with a small tear of conjunctiva. No subconjunctival ecchymosis. I enlarged the wound and found a sub aponeurotic collection of blood with a fissured fracture involving the temporal bone. Trephined. Ligated the anterior branch of the middle meningeal artery. Found the dura bulging presenting a bluish appearance. I incised the dura and found a large clot of blood occupying the sub-dural space. This was removed and the cavity containing it flushed with an antiseptic solution. Dura stitched and scalp wound closed. Death one and one-half hours after the operation.

Autopsy twelve hours after death showed a fissured fracture extending through the temporal bone into the middle cerebral fossa. Brain intact. Sections of brain showed ventricles empty and the absence of contusion or ecchymosis. I believe the immediate cause of death was due to the intra cranial bleeding, therefore had the patient been operated upon immediately after the receipt of the injury his chances for recovery would certainly have been much better. This case most beautifully demonstrates the correctness of my views regarding trephining in fractures of this variety, the source of the sub-aponeurotic collection of blood, and how this form of tumor closely simulates a contusion.

The above cases are a few of the many I have seen in my hospital service, but I think they are sufficient to demonstrate clearly the force of my remarks.

NOTE ON ACUTE PERIOSTITIS OF FEMUR IN CHILDREN.

By MR. EDMUND OWEN, F.R.C.S.,

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SURGEON TO ST. MARY'S HOSPITAL.

CASE. On Feb. 25, 1890, a boy, æt. 11, was admitted from Hendon with a history that ten days previously he had felt pain near the left knee, which, on the following morning, was so severe that he had to keep in bed. Two days later the thigh began to swell and he had a "shivering attack." The pain steadily increased, he lost his appetite and he complained of severe headache.

On his admission into the hospital the lower end of the femur was enlarged and very tender, and the boy could not bear to have it touched. The skin over that part was flushed and hot. There was no fluid in the knee-joint The axillary temperature was 101.8. Boracic fermentations were applied and the limb was raised on a pillow.

Next morning Mr. Owen saw the boy and at once ordered an incision to be made down to the femur upon the outer side through the space between the ilio-tibial band and the tendon of the biceps. The operation was performed after the method of Hilton, and a large subperiosteal abscess was evacuated, the bone being found bare over a considerable extent. The cavity was then thoroughly irrigated with hot carbolic lotion, 1 in 40. The temperature, which before the operation was 102.8, descended shortly to the normal line. On the evening of the fourth day it again mounted to 101°, but after that it scarcely departed from normal. Provision was made for drainage, the wound was dressed with mercuric gauze, and the limb was fixed on a back splint. Iron and quinine were prescribed, and some port-wine was ordered. After the tension had been thus relieved the boy began to sleep well, and his appetite returned; he greatly improved in aspect, and he left the hospital well and strong toward the end of May. No necrosis occurred.

Remarks.

The lower end of the femur is a favorite region for acute periostitis in children. The disease is usually marked by great constitutional disturbance—often with delirium, there is, on comparing the two sides, a deep-seated, central thickening. Treatment must be prompt; there should be no dallying with opium, salicylic acid, evaporating lotions, fomentations or leeches.

Nor should the practitioner wait for "fluctuation" before using the knife. A clean-handed surgeon should not hesitate to cut down at once on to the swollen femur; traversing the anatomical space indicated above, he will reach the bone without danger or difficulty. Delay, on the other hand, entails many and great dangers: pyæmia, necrosis, chronic suppuration, hectic, albuminoid disease, destruction of the knee-joint. Hesitation and irresolution in the case of periostitis of the femur have many a time involved the surgeon in using the amputating knife instead of the scalpel, or have condemned the child to endure an agonizing pain which has ended in delirium and death. My experience in some of these desperate cases has been that the practitioner has had too much of the mind of Macbeth, who argued with himself when about to use the trenchant blade: "If it were done, when 'tis done, then 'twere well.

"It were done quickly." He knew what he wanted to do, but he had not the courage of his opinions. "Infirm of purpose!" said his clear-headed spouse, "Give me the daggers." In dealing with acute periostitis in children more of the spirit of Lady Macbeth is needed.

THE MÜTTER LECTURES ON SELECTED TOPICS IN SURGICAL PATHOLOGY.

SERIES OF 1890-1.[1]

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LECTURE IV.

THE RESULTS OF THE ABSORPTION OF THE PRODUCTS OF WOUND INFECTION.

Syllabus.—Surgical Fever. Intestinal or Enteric Toxæmia, and its relation to surgical cases. Sapræmia or poisoning from "Septic Suppositories." Septicæmia. Pyæmia; idiopathic or spontaneous; from causes unexposed to the external atmosphere; from old inflammatory foci. Spontaneous suppuration in previously healthy persons. Resumé of Rinne's experimental researches concerning production of sepsis.

FOR PRESENT purposes and in the light of the pathological knowledge of the day, I propose to group under five distinct headings the various septic disturbances which may result from injury or wound, which in time past have been variously regarded and classified, and which furthermore have been all summed up by the laity under the comprehensive, yet inaccurate name, blood-poisoning. These five forms are as follows:

1st. Surgical fever.
2nd. Intestinal toxæmia.
3rd. Sapræmia.
4th. Septicæmia.
5th. Pyæmia.

[1]Delivered before the College of Physicians, Philadelphia, December, 1890.

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First.   Surgical fever.—Under the term surgical fever, asep-
tic wound fever or fermentation fever, are included those im-
mediate febrile disturbances which result in two or, at most,
three days after an injury or a wound.   This form is charac-
terized mainly by pyrexia, with only so little nervous, emo-
tional or digestive disturbance as seems always to accompany
the same grade of pyrexia.   It was called fermentation fever
by Bergmann because it was supposed to be due to the fer-
mentation of some fibrinous substance, or to be connected in
some way with the fibrinous ferment.   It has been shown by
numerous observers that the introduction of blood into healthy
animals by transfusion would produce a rise of temperature,
indeed intravenous injections of clear water, or of salt solution,
have the same effect, as do also injections of aseptic emulsified
substances, such as water containing finely pulverized char-
coal, in suspension.   Bergmann further showed that such a
fever may also be produced by intravenous injections of pan-
creatin, pepsin and trypsin.   It would appear further that
albuminoid substances when undergoing oxydation occasion
rise of temperature, which proceeds until the products of oxy-
dation are eliminated through the kidneys.   The most proba-
ble and most satisfactory explanation of surgical fever is that
it is due to the trifling disturbance attending absorption of
minute products of aseptic tissue necrosis, or the oxydation or
metabolism of the same.   It is not always met with, and may
vary in degree according to the age and condition of the subject.
It speedily subsides by lysis, and has in it absolutely noth-
ing implying sepsis, nor is it anything except a phlogenic con-
servative process.

Second.   Intestinal toxæmia.—I give this topic a distinct
caption of its own because I am very sure its importance is al-
ways under-rated by students and junior practitioners, and of-
ten by their seniors, as by writers generally.   Indeed, under
this term are included conditions which, perhaps, deserve to
be grouped separately, though as yet we lack such accurate
knowledge as shall permit a proper classification.   Intestinal
sepsis or *enterosepsis* has, indeed, been mentioned by Billroth,
and by other writers, and yet it has been difficult to determine
precisely what they meant by these terms.   *Enteritis septica*

is described by Gussenbauer, but it is hardly the term to apply to the condition now under consideration. Under this caption, then, I include, 1st, a condition of unusual, or at least undesirable activity in the contents of the intestinal canal, by which, whether due to common or specific forms of bacteria, the ptomaines of putrefaction are produced in such manner, or such quantity, that they are absorbed through the intestinal mucosa, and distributed over the body, by which a condition of intoxication is produced. In this form it is not meant to imply that any of these bacteria gain access to the circulation, only that a more or less profound toxæmia is produced. 2nd, a form in which the common or uncommon bacteria met with in the intestinal canal pass into and infect the living tissues of the patient, and produce local or general infection in addition to the toxæmia above described. That the first form occurs alike in surgical and medical cases I think no one will deny. That the second form is possible, if not common, is made sure by such researches as those of Karlinski. He fed animals with milk infected with staphylococcus aureus. Among forty-eight experiments he found six times general infection with swelling and reddening of the intestinal mucosa, while the fæces and the blood both showed the same cocci. Five times he found suppurative parotitis without intestinal lesions; seventeen times acute and fatal diarrhœa; eight times general infection with metastatic abscess. (He often noticed an increase of virulence after passing these cocci through these animals.) (*Prager Med. Woch..* 1860, No. 22.)

Aside from these experiments of Karlinski, there are numerous other observations all tending to show that the most common inhabitant of the alimentary canal, the *bacterium coli commune*, may be taken up by the intestinal absorbents and conveyed to at least neighboring points, where it may set up abscess with its attendant symptoms. It is extremely probable also that other intestinal organisms may take the same course. In this way, for instance, are to be explained the abscesses in the liver which accompany or follow dysentery, and in which living organisns have been described by Kartulis, by Osler and by others.

A very careful study of the pathological and infectious properties of the bacterium coli commune has been very recently published by Tavel, of Berne. (*Corres. Blatt. f. Schweizer Aerzte.* Juli, 1889, page 347). It was in 1878 tnat Kocher emitted the idea that suppuration of goitrous tumors was due to a secondary infection from the intestine, consecutive upon an enteritis. Tavel, studying two such cases carefully, was able to obtain pure cultures from the pus of a bacillus which produced gas, and which closely resembled bacteria of the large intestine. These he described in 1887. During the present year he had opportunity to study yet another similar case. In February there was operated upon an enormous goitrous tumor composed of two cysts; one of these was completely enucleated, the other partially so. During the operation there was a violent hæmorrhage which was checked by pressure with sponges. Some hours later there was collapse, and infusion of salt solution for the relief of the traumatic anæmia was practiced with success. A little later, on account of secondary hæmorrhage, the dressing was removed and compression with sponges again practised. The next day the drain was removed, as usual in Kocher's clinic, and was placed in jelly without developing any colony until after it had been present several weeks, when there developed a small coccus which did not liquify the gelatine. In the meantime cicatrization of the wound as complete, when there presented a hæmatoma which called for puncture. At this time two cultures were made from the blood of this cyst; one of these developed a pure culture of a short bacillus, which by accurate comparison was positively idertified as the bacterium coli commune. The subsequent course of events in this case was very different from that of a mixed surgical infection. The walls of the hæmatomatous cavity became necrotic, but secreted neither serous fluid nor pus. When this cavity was scraped out later, there was removed a small fragment of sponge. Strange to say the sponge contained no bacteria, nor did the fragment removed, and the question is, did the bacteria of the large intestine reach the spot through the circulation, or did they spread there through the skin. Tavel seems to be of the opinion that in this case they reached the wound at the time when the infusion was practiced. Nev 'heless, that the bacterium coli commune may become pathogenic, and, prolife ng in the blood, spread to the intestine, the same author has made certain by a series of experimen s, since after intra-venous injections numerous animals died, and in all their organs were found large numbers of these organisms. Even subcutaneous inoculation was enough to cause death in numerous instances. Such cases as Tavel's at least demonstrate the possibility of a rare complication of wounds, and illustrate especially the necessity of paying particular attention to the intes inal canal both before and after operations.

This second form, however, is much less common than the first, and need not long detain us at present. It is especially to the disastrous results of the detention in the alimentary canal of excrementary material to which I desire to call attention now. It unquestionably brings about a condition of pyrexia, of disturbed secretion and excretion and brain action, and of wound healing, which may at times be mistaken for sapræmia or septicæmia, which may by reasonably intelligible processes be converted into one or the other of these forms,

and yet which it is necessary to sharply distinguish from them. For instance, a patient with a trifling or a serious wound passes the period when we may reasonably expect a conventional amount of surgical fever, and then, owing to inattention or ignorance, permits the bowels for some days to accumulate material which should not have been retained. As a consequence of the putrefaction of this material ptomaines or leucomaines, or other toxic substances, are formed, whose absorption is favored by their retention. That the patient is thereby poisoned is soon evidenced by mental hebetude or excitement, by pyrexia increasing in degree, by fetor of the breath, by furring of the tongue, as well as by other well-known and easily recognizable signs and symptoms. Fear of blood poisoning being aroused, the region of the wound is now examined. Unless this condition has advanced too far there will be found here little or nothing to explain the evident signs of poisoning. Should now inquiry be directed toward the condition of the bowels, most significant information will probably be gained, acting upon which a laxative enema cathartic, or both, will be administered, and with the expulsion of the poisonous material the unpleasant symptoms will speedily subside. How often has this been the experience of every practitioner and, yet, how insufficiently has he reflected upon it!

It would be a mistake, however, to suppose that only when a history of constipation is obtained can this condition of affairs result. It often happens, from causes not understood, that there takes place within the intestinal laboratory such a putrefaction as produces ptomaines which are at the same time toxic and cathartic in their action, so that the irritating material is expelled by virtue of the very poisons which it has produced ; and it furthermore often happens that the exhibition of a vigorous cathartic, for instance, one of the mercurials, will so admirably clean out the entire intestinal canal, that not merely is this entire toxic action prevented or checked when present, but that a most happy effect is exerted upon septic disturbances commencing elsewhere.

I regard this intestinal toxæmia as a subject of immense importance, further, because I am convinced that a condition

which begins as a disturbance of this kind may become merged into one of the more serious or septic conditions to be mentioned soon, thereby flooding the area of the wound with organisms introduced directly from the alimentary canal, or so depressing the vitality of the patient as to permit true putrefactive or pyogenic infection from without, when this would not otherwise have occurred.   In this connection it is of value to recall that particular function of the liver which has been termed its depurative action, by virtue of which it filters out from the portal circulation those elements which are harmful or toxic to the general economy.   It will thus be seen that its role in preventing intestinal toxæmia is a most important one and that if it be prevented or impeded in its action the patient must suffer in proportion.   The advantage then to the surgical patient of a healthy liver is simply inestimable, and the beneficial action of a vigorous cathartic administered before an operation, and, perhaps, occasionally after it, by which the function of the liver is stimulated and its canals unloaded, may be the better appreciated.

So far as differential diagnosis between this condition and those to be spoken of, is concerned, it must be based on, first, the general, and second, the local condition of the patient.   If there be evidences of poisoning which can be traced to the wound, the trouble may well arise there ; while on the other hand, if the wound be healthy without any evidences of lymphangitis or cellulitis, and without odor or retention of secretion, the explanation is presumably to be sought for elsewhere.   Finally, in case of *doubt* the administration of a cathartic will probable settle the question.   (*Vide* also the topic of stercoral intoxication at close of Lecture III.)

Third. Sapræmia.—This term was introduced by Mathews Duncan and seems to fit the case as well as any one of the numerous expressions intended to imply the condition.   Such other terms as putrid fever, putrid intoxication, etc., are as expressive but not as elegant.   Perhaps the best definition of the term can be conveyed by an illustration of the condition itself, and for this purpose none will serve better than that physiological operation of nature's own performance, namely, the act of parturition.   By the completion of this operation there

is infl'cted a fresh and bleeding wound of large area, which is more or less exposed to putrefactive agencies. By the comclusion of the act and the contraction of the uterine walls there is left a comparatively small cavity which must contain a small amount of freshly coagulated blood.It is unnecessary to speak of what occurs when the puerperal state is passed without incident, but let us suppose that on the third or fourth day the patient is found with a flushed face, dry tongue, some mental disturbance and a considerable degree of pyrexia, while we are informed that the lochial discharge is altered both in appearance and in odor, the latter being now offensive. The ex· planation of affairs is very simple. Germs of putrefaction which were introduced by carelessness during the act of labor or afterward, have lodged in the contained blood-clot, have caused putrefactive processes, as the result of which ptomaines have been formed. We have then a condition of putrefying and poisonous blood-clot contained within a mass of tissues in which changes and absorptive processes are rapidly taking place; in other words, within a locality where absorption is highly favored. The condition being recognized an antiseptic douche is administered, and frequently repeated, by which means putrefaction is not merely checked, but abolished; and, the source of poison being removed, the natural recuperative powers of the patient enable her to recover within a few hours from the dose of poison received.

In this case we have had to deal with putrefaction occurring within a body cavity, and yet not involving the living tissues of that body. In other words just such a poisoning as might occur if we were to take rotting blood-clot and deposit it in a pouch under an animal's skin. Precisely such a condition of affairs occurs in surgical work. In an amputation stump a certain amount of bleeding has occurred, due, perhaps, to insufficient hæmostasis or to lack of proper quietude after the operation. This clot becoming first infected from a failure in antiseptic practices, begins to undergo changes in a precisely similar manner, and the patient to show signs of poisoning. If now these be recognized in time, and antiseptic irrigation with adequate drainage be established, the harm already done

can be quickly undone, while the patient has suffered only a
temporary toxic excitement.

In the writer's estimation it would be well to limit the term
sapræmia to just so much disturbance as is included in the
above illustrations, and to extend it no further. Just so soon
as the putrefactive action extends from the contained clot to
the containing tissues, the case should cease to be considered
one of sapræmia, and should now be regarded as one of sep-
ticæmia. It is necessary then to add to the above statements
only this, that a distinct form of intestinal toxæmia may be-
come converted into one of sapræmia, simply by a continua-
tion of the orginal condition which predisposes to the other.

Fourth. Septicæmia.—For the writer the difference between
sapræmia and septicæmia is not one of character so much as of
location. The idea conveyed by the term sapræmia is in-
tended to be that of a putrid suppository, if one may introduce
this illustration, from which absorption is continuously taking
place; whereas in a case of septicæmia the putrefactive action
is no longer confined to material enclosed by, yet strictly
speaking without the tissues, but has spread from this to the
tissues themselves. Pursuing our previous illustration still
further, let us suppose that the recently delivered uterus has
contained for some hours its putrid intra-uterine suppository of
breaking down material. Presumably by the deleterious
action of the poisons therein produced the vulnerability of the
tissues has been so far lowered that they no longer resist the
action of the micro organisms present. So soon as these have
begun to attack the still living tissues, their action is, at least
within certain limits, progressive; not so much by means of
the circulation as by means of the continuity of tissues, the
systemic poison all the while being intensified. So rapid may
be this action, as it seems to be in many malignant diphtheri-
tic cases, that the individual speedily succumbs before many
evidences of abscess or local gangrene can appear. Or on the
other hand providing that the toxic action be less pronounced
or the patient's vitality more enduring, or providing also, which
amounts to the same thing, that his tissues are more resistant
locally, then abscess or local gangrene may result, the destruc-
tion of tissue being limited to the part first involved. Should

this have been the uterus this favorable local destruction is less likely to occur, but should it have been in an extremity a natural separation or a mutilating operation may be the means of saving the patients life.

From what has been said, it will be seen how easily a case originally sapræmic may become merged into one of true septicæmia; but it is not intended to imply that the sapræmic condition must always preceed, since many cases begin as pronounced septicæmia from a local infection. When we have to deal with a retained and putrefying blood clot, the case is usually of the former character, but when with a direct local infection, as for example, a dissecting wound, it is usually septicæmic from the beginning.

Fifth. Pyæmia.—The distinction between septicæmia and pyæmia also is one not of toxæmia, but of the formal progression of a series of embolic disturbances, which give rise to the formation of metastatic foci and abscesses, along the lines so well laid down by Virchow. Just what it is which *determines* the formation of minute thrombi and their dislodgement and transportation first to the lungs and later to the system at large, we have not yet determined. Still, so far as can be seen, the distinction between purely local ravages such as those implied in a typical septicæmia and the dissemination over the body of hundreds or thousands of minute, infected emboli, which is comprehended in the term pyæmia, is a matter not clearly understood. It may be pure accident, or it may be something not yet clearly grasped by our apprehension; at all events it scarcely seems to be due to any pathogenic differences in the bacteria involved, for, so far as we at present can see, precisely the same organisms may produce at one time the former character of disturbance, at another the latter. Nor is the matter cleared up by a post-mortem examination of the parts primarily involved, since we are quite likely in each case to find the local veins more or less filled with clotted or semi-clotted blood, with everything favorable for its transportation to all parts of the body. It is scarcely enough to say that we have rather a phlebitis to contend with in the latter case than in the former, since that would imply that in the latter instance

the walls of the veins are more easily permeable by the bacteria at fault.

It is acknowledged that in the above description of these various forms their more typical manifestations have alone been utilized. That intermediate or mixed forms are frequently met with is distinctly acknowledged by the introduction into literature of such expressions as *septico-pyæmia*, *pyo-sephthæmia*, etc. The term *kryptogenetic pyæmia*, introduced by Wagner, scarcely has any place now, inasmuch as we cannot conceive of any form of surgical sepsis which is not kryptogenetic in its etiology.

Few subjects, if any, have more deeply engaged the attention of surgical pathologists than those included under these above headings, and to attempt to summarize the literature and the views of the past, would be to lay before you a work at least no smaller in volume than the scholarly treatise of Gussenbauer. Nevertheless, with the introduction of bacteriological studies into surgical pathology, new phases of old questions have been presented and a vast amount of laborious research has been devoted to illumining them. Since Koch's masterly and path-breaking treatise on the infectious diseases, no original work has appeared upon the subject so creditable in its attacks, and so replete with experimental investigation, as that of Rinne, to which we purpose to give some attention in detail.—*Archiv. f. klin. Chir.*, Bd. 39.

The term Pyæmia was first suggested about fifty years ago by Piorry, and was used by him and others in the old humoral sense. Later the name was continued by Virchow though retained in a revised meaning. With such revised views, with the introduction by Recklinghausen of the term *embolus*, and with a recognition of the possibility of *capillary emboli*, the phenomena of metastasis became susceptible of easy explanation. That bacteria, introduced through respiratory or alimentary passages, or some open wound however small, or carried by the body juices from some local infection, are important contributing agents in this process, is a matter of much more recent development. We have learned furthermore that while it is within their province to thus provoke suppuration, deep or superficial, mild or fatal, there must be certain

favorable disposition of the fluids or tissues to permit such action. We may say that their resistance is lowered; we may call it reduced vitality; we may call it vulnerability;—it matters comparatively little so long as we appreciate the fact.

While we are yet blind to all that constitutes this predisposition we may yet recognize certain conditions as predisposing to suppuration; *e.g.*, subcutaneous injuries, extravasations of blood, presence of foreign bodies, etc. We all acknowledge the existence of *loci minoris resistentiæ*, but can explain very few of them. The endeavor to account for them leads one into a very wide and yet untrodden territory.

As showing what emboli may do, take the following illustrations:

Fraenkel made a very careful study of two cases of sepsis taking its origin from the pharynx. One was a case of pericarditis and double pleurisy. The exudate at first sero-fibrinous, later contained the streptococcus pyogenes. Endeavoring to explain its occurrence in these closed cavities he maintains that organisms, aside from that of tubercle, can reach pleuritic exudate in either of the following ways:

1. When the pleuritis is of an embolic character and when the emboli are already infected.

2. When bacteria are or can be recognized in the blood.

3. When the pleurisy is the result of inflammation spreading from a neighboring infected area by continuity of tissue, and along the lymph vessels which spread to the pleura.

In his first case thus studied there were extensive diphtheritic pharyngitis and laryngitis, followed by a large retro-pharyngeal abscess, which later involved the right tonsil and then spread into the posterior mediastinum. Consequently here the infection was according to the third method mentioned above. At autopsy the same streptococcus alone was found in all the lesions.

In the second case a provisional diagnosis of endocarditis ulcerosa was made. At the autopsy there were found widespread diphtheria of larynx and pharynx, purulent infiltration of the tonsils and their neighboring tissues, myo- and endocarditis diphtheritic, hepatisation of both lungs (catarrhal pneumonia) and large white kidneys. Streptococcus pyogenes was found in the tonsils, the lungs, the diphtheritic membrane, on the inner surface of the heart and in the capillaries of the kidneys.

He compares these cases with those reported by others where the pharynx was apparently the port of entry for septic organisms. For instance, Gerhardt's case of facial erysipelas, which proceded from the tonsils, and cases of streptococcus invasion following scarlatina reported by, among others, Löffler, Heubner-Bahrdt, and Freudenberg.

Wagenmann has reported a case of puerperal fever, in which total blindness occurred within a few hours. Dissection demonstrated pyæmic foci in various organs. Multiple, extensive emboli of the vessels of each eye were found, the emboli consist-

ing of masses of streptococci. After rapid proliferation inside the vessels these
cocci escaped from their walls and were met with free in the retina, vitreous, etc.
Furthermore, wherever the cocci were found was found also pus. The former were
not found without the latter.

Rinne makes a clinical division of cases of suppuration and
general sepsis which has much to justify it, though the minute
causes may not vary correspondingly.

1. Metastatic abcesses which occur in a typical way without
visible or known external injury or lesion. Spontaneous
pyæmia.

2. Pyæmia and septic cases with a recognizable and causa-
tive lesion.

3. Subcutaneous suppuration at points where there had pre-
viously been inflammation; *e.g.*, abscess following *brisement force*
of a joint anchylosed from a former rheumatic attack.   A case
to belong in this group must be absolutely free from any lesion,
however slight, of any part of the surface.

I.   *Idiopathic pyæmia.*—Perhaps our best illustration of so-
called idiopathic pyæmia can be met with in a case of spon-
taneous acute infectious osteomyelitis.   There is perhaps no
disease of whose bacterial origin we are more certain, and we
are familiar with all the microbes which have the power of
producing it, yet why they select the osseous system, or rather
certain parts of it, *i.e.*, usually the diaphyses of long bones, for
their attack is a question which we can not yet answer satis-
factorily.   Or, with Rinne, let us frame this question a little
more accurately: Why are the bones selected in such a case
as the above, when in a general infection with equable distribu-
tion of the blood every tissue enjoys apparently equally good
opportunities?   Such a question misleads, however, if one
takes it for granted that all parts of the body are equally liable
to invasion by any given organism.   Grawitz especially has
shown that there is no bacterium which manifests no preference
for one tissue or organ over another.   Tubercle, *e.g.*, affects
commonly the lungs, liver and bones, relatively seldom the
testicles or ovaries, and very rarely the salivary glands or
muscles.   The same organ may be exempt at certain periods
of life.   The brain in childhood, especially the meninges, is a

frequent seat of tubercular disease; in adult life rarely so, since it usually escapes in cases of acute general miliary tuberculosis. The bone marrow and synovial membrane are frequently affected in childhood, in adults they commonly escape, though in the acute miliary tuberculosis of adults the bone marrow is again a point of predilection.

Measles and leprosy affect especially the skin, gonorrhœa involves only certain mucous membranes, typhoid fever certain intestinal structures, glanders the skin and lymph-glands, and so on through the list of infectious diseases. In tuberculosis the vascular peculiarities of pia, which is especially rich in lymph vessels, or of the synovialis, may be of effect, or the more torpid circulation in the liver, but such hypotheses as these seem insufficient when we recall that whole systems, like the muscular, including the heart, escape.

It appears then to be a natural law that every disease germ has a preference, so to speak for particular tissues and organs, although of the explanation of this fact we are profoundly ignorant. Only by an overwhelming infection, or when the normal energy of the tissues and cells is altered, is this law set aside. Viewed in this light indiscriminate metastases are violations of this law.

Among all the defensive powers of the system the capability of resorption is perhaps the most important protection enjoyed by the cells and tissues comprising the organism. This power seems to be enjoyed in the highest degree by the peritoneum, which is known sometimes to tolerate and dispose of relatively large amounts of infectious material. Grawitz and Rinne have shown how many pyogenic cocci can be introduced into the peritoneal cavity without inducing peritonitis, provided only—and this is very important—the wound made in performing the experiment is properly disinfected and made to heal *per primam.* The resorptive powers of the unbroken peritoneum are therefore very great. (Vide Lect. V.)

Experiments which lead to a contrary conclusion are to be accounted for by a failure to protect the peritoneal wound. Practicing surgeons are now availing themselves of the lesson thus taught, and are closing peritoneal wounds with great caution. That the peritoneum is by no means suppuration proof

thousands of autopsies have shown; on the other hand, that the healthy, uninjured peritoneum has marvellous powers of absorption of septic germs has been equally proven by hundreds of experiments. Between the two statements there is no discrepancy; it is simply a question of its disturbed or undisturbed condition.

The next most important self protection manifested by the organism is in the degree of concentration of its albuminous fluids. Pyogenic cocci can not thrive in highly albuminous liquids. Upon a mixture of equal parts of gelatine and blood clot they scarcely grow, and in a similar mixture of pus and gelatine they do not develop (Rinne). The explanation of the measure of success attained by means of the "open method" of dressing wounds is hereby furnished; the fluids which exude from the exposed wound surfaces are too rich in albumen for pyogenic or saprogenic action to occur.

As the third variety of auto-protection we must—with some misgiving—mention *phagocytosis.* A discussion of this much vexed matter would lead too far from the present inquiry; consequently, as it has so much about it that is plausible and attractive, I must simply take the ground that it is entitled to enumeration here until its occurrence has been positively disproved.

In the combination of these three defensive capabilities we find the means by which the body, by its component parts, rids itself of the offensive germs, that is when such defense is wholly successful. When successful only to some extent it is because some part, large or small, has been sacrificed to save the balance. The portion thus yielded to the enemy is now dead, and nature at once provides for its extrusion. Under circumstances included in our investigation this extrusion is brought about either by abscess or by sloughing.

Certain well known conditions conspire to prevent defensive action on the part of the tissues, particularly severe complicating general diseases, such, e.g., as typhoid. Such a disease saps the vitality from our cells, and interferes with, if it does not inhibit, their proper function.

A condition of *predisposition* is everywhere recognized and nowhere defined or explained. Still when we keep in view the

varying degrees of virulence which can be demonstrated in
certain bacteria artificially cultivated, we can, perhaps, ascribe
more or less of the so-called predisposition of our tissues in
reality to varying degree of pathogenic potentiality in the
bacteria which invade them. For instance it is well known
that tubercle as well as anthrax bacilli need to be passed
through a living animal body at least as often as every fourth
culture in order that they should preserve their virulent powers.
Whether in this way their "animosity" against animals is
excited, or whether their ptomaine-excreting power is in-
creased, or whether one necessarily implies the other, is more
than one can say.

Under ordinary experimental circumstances it would appear
to be necessary to inject such a quantity of the common pyo-
genic cocci that with them should be inserted an appreciable
amount of their ptomaines in order to call forth in the animal
injected any sign of more than trifling disturbance. Even
when the blood of a patient is swarming with these cocci the
distinctive features of pyæmia (*i.e.*, metastatic abscesses) are
exceptional, and the case is usually one of septicæmia. The
nearly if not absolutely complete identity of acute osteomyeli-
tis with pyæmia can be explained by the peculiarly confined
limits within which their rapid growth is pent up. Again when
richly lymphatic structures, as *e.g.* the lymph glands, are in-
volved in a septic process we see how easily microbes may
gain access to the blood, and how quickly the whole body may
be affected. Conversely we see also how the lymph glands
must act as neighboring filters for lymph vessels which are
carrying away from the given lesion the absorbed infecting
materials, and why they are very easily involved and often
suppurate. No matter if chemical products of bacterial growth,
or alkaloids isolated from putrid material, have been known to
cause suppuration, they have never been known to cause
metastatic abscesses. Many dogs have succumbed to doses
of filtered cultures; they have died of toxæmia, showing
somnolence, diarrhœa, collapse, etc., but there *never* have been
found in their bodies any metastatic abscesses. All this goes
to prove that pyæmia is something more than excessive pto-
maine poisoning. The fulminating septic symptoms thus pro-

duced by Panum and v. Bergmann had nothing of the anatom-
ical picture of pyæmia about them.

II. *Pyæmic and septic cases with a recognizable and causa-*
tive lesion, unexposed to the atmosphere.—A typical case of this
kind would be a suppurating subcutaneous fracture, such as
Volkmann has described (*Beitrage zur Chirurgie*), or a sup-
purating goitre.   In such cases we only need to find the port
of entry of the pyogenic organisms in order to explain the
rest.

Rosenbach, Passet, Krause and Wyssokowitsch, among
others, have shown that when the blood is laden with infec-
tious bacterial material, it needs usually only some subcutane-
ous injury to constitute the *locus minoris resistentiæ*. I say
usually because Rinne found that even after injecting very
large doses of staphylococcus cultures into the peritoneum frac-
tures made subsequent to the injections healed as usual,
although even the injections were contined day after day.
Whether in his experiments the blood of the animal injected
was found to be germ-laden he does not tell us.

Rinne further details a number of experiments in which
numerous and repeated injections of pure cultures into veins
or tissues failed to produce any sign of suppuration, or of dis-
turbance of union in fractured bones; and he claims—undeni-
ably—that mere presence of bacteria is not enough, that we
must seek yet further for the explanation of suppuration and
sepsis in cases belonging to this group. And although it
seems to make a difference what kind of animal is experi-
mented with, and while consequently man may be more
vulnerable than some other animals, yet it is quite in ac-
cordance with our experimental experience that in our clinical
surgery we may find surprises of this character equally signi-
ficant.

A parallel is found in the results of the experimenters (Orth,
Wyssokowitsch, Prudden) who have found that an artificially
injured aortic valve creates a local predisposition for the germs
of malignant ulcerative endocarditis.   This injury is in effect a
lesion of the tunica intima, and this seems everywhere to have
the same effect.

But it is undeniable that such subcutaneous injuries as those

above alluded to do create vulnerable points of attack for any micro-organisms circulating in the blood, even though these latter may not always take advantage of them. When bones are broken soft tissues are usually also torn and bruised. How is it that we find the suppuration usually in the bone, rather than in the surrounding muscle? Possibly it may be that the vessels of the soft parts are more crushed than those of the bone, so that the bone wound is more likely to be flooded with bacteria than any other region. Or is the warfare of the cells more actively waged by those of the soft tissues? To my mind it is a combination of both.

Experiments failing to clear up these important problems, we may yet endeavor to discover the exact role played by the chemical products of bacteria, and to see if we can trace any mutual relationships between bacteria, ptomaines and wounds, by which blood poisoning resulting from infection of a point of least resistance can be explained.

The experimental work of Grawitz, de Bary, Scheuerlen and Fehleisen has demonstrated that beside the invasion of the tissues with swarms of bacteria, there is a simultaneous action of their toxic products, which either actually results by itself in production of pus or else permits their rapid growth. It it not so much a question now as to whether injections of cadaverin, as perhaps the best known of the ptomaines, can under unusual circumstances lead to pus formation. Still less is it necessary to show how such active chemical agents as turpentine or ammonia may lead to the same result by themselves, causing a toxic action, or by inhibiting the normal chemical activities of physiological fluids, or by producing gangrene of the skin and favoring bacterial infection from without, or by so preparing the soil that its vital resistance is greatly lowered.

Clinical surgery has ordinarily no such lesions to encounter as those caused by such laboratory experiments. Rinne set himself an experimental task in which he tried to ascertain the activity of such chemical poisons as take part in the inflammatory and septic process and to learn whether they alone can cause suppuration or whether they simply favor the action of bacteria. These experiments were made with:

1. Sterilized fluids in which staph. aureus and albus, and streptococci had been cultivated and then killed by heat.

2. Sterilized putrid fluids, such as that from putrefying meat, etc. These were carefully filtered and cooked, and tested before use.

3. With Brieger's cadaverin.

They were moreover conducted with a view to ascertaining whether these substances produced either inflammation or suppuration in normal, freshly injured or cicatricial tissue or around foreign bodies.

His results briefly were as follows: Injections of sterilized staphylococcus cultures and putrid fluids into healthy subcutaneous tissues, with due precautions, do not produce pus. Even inflammatory reaction was usually absent, and he never made an abscess. Subcutaneous wounds with ecchymoses did not suppurate. He inserted shreds of wool and left them a month, and still such injections made in their proximity failed of pyogenic effect. Even when these threads were soaked in such fluids the result was the same. Equally negative was the result of injections into old cicatricial tissue. Inflammatory signs were in some instances evoked, but resolution quickly followed. After injection of large quantities of sterile staphylococcus cultures abscesses whose pus (?) was free from bacteria were a few times noted, but more often resolution occurred. After introduction of equally large doses of sterile putrid fluids necrosis sometimes occurred, which would naturally be followed by bacterial invasion. Sterile abscesses following these latter were not seen.

Worsted threads soaked in these fluids, and then variously introduced and into various tissues, gave rise for the most part only to inflammatory exudate around them, which was quickly absorbed; only very exceptionally did a very mild suppuration take place about them.

Experiment with cadaverin, according to Rinne and Grawitz, may be summarized as follows:

Solutions of cadaverin, free from bacteria, subcutaneously injected, produce according to their degree of concentration and value either a caustic action, or inflammation with termin-

ation in suppuration, or inflammatory œdema with subsequent resolution.

In $2^1/_2\%$ solution—or stronger—cadaverin completely kills the bacterial culture (staph. pyog. aureus) to which it is added. Weaker solutions in proportion to their strength delay or interfere with their growth.

Still further experiments have been made with ptomaine solutions to which living bacteria have been added. For this purpose pure cultures (gelatine and agar) of the staphylococci and streptococci were mixed with distilled water, and to this was added fluid in which had been macerated putrid meat, etc. This mixture was filtered and repeatedly sterilized, and then to it were again added fresh cultures of the aforesaid bacteria. Fluids thus or similarly prepared were experimented with in varying quantities. Small animals were found for the most part to be capable of disposing of 1 cc. of such mixtures without abscess formation, though local reaction was for the most part more acute than when pure cultures alone were used. In order to differentiate still better, pure cultures were injected upon one side of the animal's body, and pure ptomaine solutions upon the other. It seemed to make very little difference how the experiments were varied. Quantities up to 2 cc. seemed innocuous, even though injected into previously bruised tissues. Just where the line could be drawn between innocent or noxious amounts seemed to depend upon the particular ptomaine, its strength in solution, the kind of animal and its condition. It is Rinne's opinion, however, that ptomaines do, as it were, prepare the soil for bacterial attack, and that under their influence pus is more easily produced. In other words *under ptomaine poisoning of a certain degree of severity suppuration is favored and spreads*; but if this degree of toxicity is diminished or increased suppuration does not take place. If this toxæmia is combined with a traumatic lesion, suppuration may be quite circumscribed on account of a very lively cell proliferation by which a zone of protection is afforded.

Although, then, these artificial conditions thus produced in animals find no counterpart in man, they teach at least that pus production is not a specific action of one bacterium, but that local œdema, suppuration, necrosis and even sloughing

may be the occasional result of an irritation of a purely chemical character. The most important practical bearing of these facts experimentally elucidated is that by chemical means the normal resistance of healthy tissues may be reduced, and that the local condition, in such cases, is not so much a question as to the violence of the local lesion as of the resistance of the cells composing the tissues involved. Such a lowered resistance may be the result of local conditions, *e.g.*, frost-bite, mechanical strain etc., or very commonly of constitutional disturbances, such as struma, scurvy, gout, diabetes, syphilis, typhoid, scarlatina, diphtheria, puerperal fever, etc.

Take, for example, Lembert's and Kocher's researches concerning acute suppurative strumitis; they found it six times following after typhoid, three times after pneumonia, once after bronchitis. and once after puerperal fever, and also after acute gastro-intestinal catarrh. (*Deutsche Zeitschrift f. Chir.*, bd. x.) Five times along with the suppuration they noted putrefaction of the pus with formation of gas before opening the abscess. Furthermore they noticed that the thyroidal trouble did not begin during the general disease but as a sequel. Numerous other observers have noted the same feature in other manifestations of an analogous nature, as post-typhoidal phlegmons, etc. Thyroidal abscess is practically unknown as the result of injury alone; it results only from reduced vitality of the local tissues. For instance, thromboses. hæmorrhages, retrograde metamorphoses, in a goitre, constitute so many methods by which tissue resistance is diminished; to these may be added many constitutional conditions.

The thyroid is here taken merely as an illustrative organ; the same may be said of the bone-marrow, the liver, etc. The alimentary and respiratory passages offer open channels for infection, and after pathogenic organisms once enter the circulation they find their easiest prey in organs thus weakened.

In order to study more accurately the relations which ptomaine poisoning bears to the peculiar lowering of vital resistance that predisposes to suppuration, Rinne undertook a careful series of experiments based upon the intent to demonstrate:

a. Whether under otherwise similar conditions certain portions of the body developed differences of reaction under artificially produced toxæmias. For this purpose the peritoneum and the knee-joint were selected; the latter for the reason that invading cocci seem to be longer tolerated in the synovialis,

and consequently have more time for multiplication. It was necessary further to determine

b. Whether circulatory disturbances such as hyperæmia and œdema, which could be produced by ligating veins, prepared the soil for such infectious organisms; and

c. Whether trophic disturbances, such as might be caused by division of nerve trunks, exerted any influence upon the development of bacteria. The experiments were so arranged that infection was produced as well by indirect contamination of artificially induced thrombi as by direct introduction of microbes into the veins.

The inferences which can be legitimately drawn from his experiments are as follows:

Through the absorption of putrid and infectious material open wounds which show a tendency to heal have this tendency so far changed that they permit the action of saprophytic organisms from the surrounding atmosphere. His experiments did not show that any localization or infection took place from such pyogenic cocci as were introduced into the circulation.

Consequently such irritative agents as affect open wounds, in such cases, come from without the body rather than from within. In other words the internal condition is one of lower resistability, which makes the external lesion a *locus minoris resistentiæ* so far as micro-organisms from without are concerned. But in the wounds which exhibited these phenomena, the bacteria which had been injected were never recognized in the discharges; such appeared to come only from the air.

The conspicuous part which thrombi play in both physiological processes and pathological disturbances is well known. Surgical experiences dating back to the pre-antiseptic days richly teach the disasters due to breaking down of thrombi in suppurating and putrefying wounds. Secondary hæmorrhage alone, from this disease, has been in time past the cause of a large mortality rate.

Degeneration of intra-venous clots in cases of periphlebitic phlegmons is even more frequent, and is an important part of the pyæmic process. Any experiments, therefore, which shed additional light upon the subject of the infectiousness of thrombi should be hailed with delight. Thrombi are inten-

tionally produced at times, as after ligaturing vessels, either in their continuity or after their division; and they form as result of contusions and similar injuries, after frost-bite, etc. It is of great importance to learn how such thrombi behave toward cocci circulating in the blood, and whether they are so far attacked by the latter as to break down into pus.

To this end Rinne undertook another series of experiments by which thrombi were formed in various artificial ways, which clots he later sought to affect by pure cultures and putrid fluids introduced by various channels. Migration of pyogenic cocci into these thrombi, or into the pulmonary emboli thereby caused, was not to be detected in a single instance. Whether the animal was suffering from existing phlegmon or abscess, or whether it was so poisoned with putrid material that it died, seemed to make no difference; *thrombi* which were *not exposed to the air* were *not invaded by the pyogenic bacteria*. Hæmorrhagic infarcts did not occur in the lungs, and pulmonary emboli caused no appearances of metastatic inflammation. If infected emboli were deliberately used in the experiment in quantity then gangrene of the lungs followed; if their number was small then each tiny embolus seemed to become encapsulated by a proliferation from the intima of the vessel in which it lodged. Something similar was observed by Panum in 1862, who found that small toxic emboli were encapsulated.

Thus from Rinne's investigations it appears that neither such thrombi from ligature of veins, nor the areas immediately adjoining pulmonary emboli, nor the clots in the pulmonary arterioles resulting from emboli, nor lesions of the intima caused by deliberately injuring it, by themselves constitute in any sense points of predilection for the activity of pyogenic cocci. That is such thrombi and emboli as are protected from contact with the air do not constitute favorable soil for pyogenic bacterial invasion.

In confirmation of these statements we have others by different investigators: thus Wegner (*Experimentelles z. Lehre von Ovariotomie, Archiv. f. klin. Chir.,* xx), claims that blood effused into the peritoneum does not decompose if air be not admitted. And Mikulicz (*Archiv. f. klin. Chir.,* xxii) has declared blood clot to be a poor soil for development of coccobacteria septica. Thus from several independent sources it is made to appear that blood clot alone, without access of oxygen, offers no attractions for the bacteria of the septic state.

III. *Subcutaneous suppuration where there had previously been inflammation or some other disturbance.*—When a joint which has become anchylosed as the result of previous rheumatic syno-vitis or of epiphyseal ostitis, and about which there are no present signs of inflammation, undergoes *brisement force*, and then without the slightest external lesion suppurates, and when, as often happens, the pus is of the ichorous variety, we evidently have to deal with a case which belongs in a class by itself, since contamination by bacteria through the unbroken skin is excluded from the possibilities of the case.

Cases with small abrasions of the skin, with ecchymoses of the skin, or with superficial hæmatomata are not included in this class. Such cases have been reported by numerous authors (*e. g.*, Volkmann and Oberst, *Centralblatt f. Chir.*, 1885, Nos. 15 and 21; Müller, in Bruns' *Beitr. z. klin. Chir.*, iii, 2; Gussenbauer, *Deutsche Chirurgie*, Lief. 4, p. 125 *et seq.*; Köhler, *Charite-Annalen*, iii, p. 464; Rinne, *Archiv. f. klin. Chir.*, xxxix, p. 71), and one case in the writer's own experi-ence has demonstrated to him their occasional occurrence. For their explanation two working hypotheses have been ad-vanced: The first that some infectious material, living or inert, gains entrance into the circulation through the respira-tory or digestive tracts, and thereupon finds in the spot affected a *locus minoris resistentiæ*; the other, that at that spot spores of the previously active germs have remained dormant, hibernat-ing as it were, till some peculiar and favoring conditions could favor their reactivity.

In an address before the Philadelphia Pathological Society, in April, 1889 (*Am. Jour. Med. Sci.*, 1889), the writer alluded at some length to this latter theory as furnishing the key to cer-tain problems in the study of acute infectious processes in bone, and towards it, as being equally explanatory of other clinical facts not relating to the osseous system, both the ex-periments of many investigators and the general consensus of opinion more and more point.

In the endeavor to elucidate this subject Rinne carried out further experiments as follows:

He operated on five dogs by introducing in their subcutaneous tissues worsted threads, most of which had been steeped in putrid solutions or pure cultures, or both. At the same time he introduced sterilized threads into their knee-joints. Nine or ten months later these animals, all of which survived the first procedure, were again subjected to endeavors to bring about infection by daily injecting into their abdomens active cultures of the pyogenic cocci, while they were at the same time fed with putrid meat or had subcutaneous injections of putrid fluids. At the same time mechanical injuries were inflicted on those parts of their bodies where lay the foreign bodies introduced months previously; they were contused or bruised, in the expectation that under the influence of the new infection acute abscess would be there and then produced. Astonishing amounts of putrescent and putrid material were ingested or injected.

The following results were obtained: At the points where lay the old foreign bodies, both in the tissues and the joints, in no instance was fresh inflammation discovered. At places where bones had been broken there was no suppuration. Subcutaneous peri- and intra-articular hæmorrhages were not infected, though the animal succumbed to septic infection, although a penetrating joint wound, though made with antiseptic precautions, suppurated. Artificial thrombi were not affected. Their peritoneums withstood numerous injections of large quantities of cultures of pyogenic cocci (Staph. pyog. aureus) without recognizable alteration. Even the pulmonary infarcts caused by small shot, by minute pieces of rubber, or by worsted fragments, did not evince the clear types of hæmorrhagic infarcts. The regions involved in the infarct areas still contained air. The foreign bodies were encapsulated by proliferation from the intima. Emboli produced by infected worsted seemed to cause gangrene locally in proportion to the amount of infectious material which they carried with them. A fragment, 1 ctm. long, was encapsulated without reaction like an inert foreign body, although it was saturated with infectious material.

These experimental results are consequently negative in shedding the desired light; they serve to show, however, the wonderful powers of resistance possessed by certain animals. In spite of their significance in veterinary or comparative pathology we must, nevertheless, accept the teachings of clinical experience in diseases of man, since nothing appears much more certain than that recedives of suppurative and septic trouble occur in old foci of previous disease of similar nature, or localities not far distant.

In an inquiry of this character one easily reaches a limit beyond which investigations fail to give the desired information. Some of our most characteristic cases of this class occur as sequelæ of typhoid or some other of the infectious fevers. These fevers we cannot reproduce in animals, and, consequently, we cannot imitate in the laboratory the condition which so concerns us in the sick room. Again, it seems next to impossible, some say quite so, to produce a typical form of acute infectious osteomyelitis in such animals as we use for experimental purposes. Our closest laboratory imitation of this disease in man lacks some of its essential features, and it seems to be almost absolutely impossible to produce it in any such way as that in which clinical histories imply that it appears. For instance, Rinne endeavored, upon 11 different dogs, by first poisoning them with various putrid products and then contusing their bones, to reproduce some of the well known characteristics. Not once did suppuration occur. In certain experiments of my own, in the same direction, though fewer in number, I have had the same negative result.

IV. *A fourth group* may, perhaps, be made of cases of so-called spontaneous suppuration in previously healthy persons, who have never had any suppurative nor infectious disease.

Thus Bruns (*Beitrage z. klin. Chir.*, i, 237) not long since reported two cases of subcutaneous spiral fracture of the femur which suppurated; both cases died of septicæmia. One presented peculiar features. Aside from the spirally broken femur there was a compound fracture of the tibial head, the knee being widely opened. The opened joint and the compound fracture were treated according to the best antiseptic principles throughout the course of the case, and showed not the slightest disposition to pus formation. But the subcutaneous fracture was surrounded by a quantity of pus. Not the slightest skin lesion was found about the limb.

Quite recently also Steinthal reported two observations (*Deutsche med. Woch.*, 1887, No. 21) bearing on this subject.

One was a fracture of a femur about which a large abscess developed and was opened 4 weeks later; the patient died of septic trouble and metastatic suppuration. Tne other case was one of old dislocation of the hip, in which efforts to reduce re-

sulted in fracture of the neck of the femur. Five weeks later incision evacuated a quart of stinking pus with the necrotic head of the femur. The patient recovered. Steinthal thinks that in the first case infection took place through the lungs, and in the latter through the intestines, since the patient suffered from diarrhœa, which was in large measure due to such diseased teeth that he could not masticate properly. He does not seem to have thought of the possibility of infection through the decayed teeth. (Vide case on page 28 of Stimson's "Dislocations.")

In endeavoring to account for these cases we must not forget how easily slight abrasions of the skin may be overlooked, or, perhaps, healed before our examination ; nor the fact that a contused and bruised, though unbroken skin, may not offer perfect protection against the penetration of germs from without. The difficulty of studying the subject is much enhanced by the rarity of such cases as those just alluded to. In the effort to elucidate it Rinne formulates a question about as follows :—Is it possible that in such cases bacteria, entering the healthy body by whatever channel they may, can segregate themselves in the subcutaneously injured tissues ?

If an exact answer can be given to this query much of the mystery attending spontaneous inflammation and suppuration is cleared up.

Wyssokowitsch (_Zeit. f. Hygiene_, I.) investigating the fate of micro-organisms when injected into the blood of warm-blooded animals, demonstrated that most of them vanished in a short time, while a certain group, varying according to their variety and the quantity in which they were introduced, increased and multiplied up to the time of the animals' death. In this latter group he placed the staphylococcus aureus.

It has been further shown by Passet and others that of the pyogenic cocci these staphylococci aurei after incorporation into the body can exist—according to circumstances—in the blood and tissue juices, in an active state, for great lengths of time. They may be then eliminated, by which convalescence or recovery are established, or they may settle in some particular locality and determine suppuration, or after rapid reproduction and ptomaine formation the animal or patient may succumb to general infection, without displaying any localized pus production. It would seem as if a subcutaneous injury should act as a _locus minoris resistentiæ_, and that if any bacteria had gained access to the circulation they would have easy access to the lesion. Such would be an easy way to explain accidents like those suppurating fractures mentioned above. Rinne planned and carried out a long series of experiments well calculated to show that subcutaneous mechanical lesions either were or were not ordinarily such _loci minoris resistentiæ_. All sorts of injuries were in-

flicted and all sorts of irritating and infectious material were introduced or injected. For instance, a sponge as large as a hen's egg was cleaned and sterilized and then infected with twenty drops of fresh pure fluid culture of staphylococcus aureus. The abdomen of a dog was then opened, this infected sponge buried there, and the wound carefully closed. At first fever, vomiting and loss of appetite disturbed the animal, but it fully recovered in six days and remained well. Three months later at autopsy there was no evidence of peritonitis. In the omentum was a tumor, which consisted of the sponge surrounded by a fibrous capsule 1 ctm. thick. *Cultures* from the substance of the sponge *returned luxurious growth of the same staphylococcus aureus.*

Similarly endeavors to establish a focus in the kidneys, by exposing one and drawing through it a piece of wool and leaving it there, closing the wound antiseptically and then injecting elsewhere pyogenic cultures or putrid material, were equally unsuccessful.

Apparently, then, this question as to the localization of bacterial activity at the site of mechanical lesions must receive a negative answer. One is astonished to find how little evidence of local action appears on section of the tissues at the point in question. After scores of such apparently crucial experiments it is noted that nothing was found here. Intentional lesions quickly healed, foreign bodies encapsulated, hæmorrhages resorbed, and not once was local suppuration observed. The clinical experiences of every surgeon afford many parallel instances.

Rinne, more than any one else, has called our attention to this aspect of the subject, that the pathological importance of the pyogenic cocci has, perhaps, been greatly overestimated in this respect, *viz.*, not merely whether they *can* produce pus, but whether they invariably *do* or *must*. Herein lies a vast difference. After their discovery some were inclined to grant them a specificity akin to that of the erysipelas germ. But of late these views have somewhat modified. Rosenbach and still more Passet, showed how frequently the staph. pyog. alb. and aureus., less uniformly the strept. pyog., produce abscess formation. But we see, sometimes, reactionless absorbtion follow, and sometimes fatal blood poisoning, after injecting the same organisms. The researches of Grawitz and de Barry concerning purulent inflammation were enough to limit the specificity of these cocci. Then Scheurlen, Fehleisen, Bumm and B. Fraenkel confirmed their conclusions, in the main, and showed that the role of pyogenic cocci in causing progressive

suppuration is really a limited one.   It has been made neces-
sary for us to seek further for contributing causes of suppura-
tion.

In 1887 (*Tageblt. der Natur-forsch. Versamml. zu Wiesbaden,*
1887, p. 157) Rinne formulated the following conclusions:

1. Animal bodies have the capability of eliminating pyo-
genic cocci, when these, after introduction into the tissues, are
protected from direct contact with oxygen.

2. A migration of cocci in a subcutaneous injury, or in a sterile
abscess produced by injection of sterile chemicals, does not
occur, nor does it, after injection into the circulation or the
peritoneum.

3. Even after direct injection into fresh cutaneous wounds,
into young or old cicatricial tissue, or around foreign bodies,
there is no suppuration.

4. It, therefore, follows that tissue lesions which determine
inflammatory reactions, at least, do not predispose for metas-
tatic suppurations ; nor do thrombi.

5. But it is comparatively easy to convert such lesions into
loci minoris resistentiæ by introduction therein of the chemical
products of bacteria.   Such a *locus* is any tissue whose nor-
mal resistance is lowered by any chemical or mechanical le-
sion; but so far as acute inflammations are concerned they do
not constitute—of necessity—such *loci* by any means.

Hence arises an inquiry of immense importance.

What sort of injury to a tissue is necessary in order to
so lower its power of resistance as to predispose it to bacterial
invasion?

From the failure of experiments already sufficiently indi-
cated it becomes evident that this inquiry needed to be directed
along other lines. Still working at the subject Rinne adopted
a somewhat different plan of action, and endeavored now to
introduce the bacterial material directly into the injured area
after inflicting a lesion.   *A priori* it would seem much easier
to thus convert such an area into a suppurative focus.   These
experiments comprised such procedures as the following:

Subcutaneous sections of tissue; immediate injection of bacteria into the section
thus made.

Subcutaneous introduction of glass balls filled with bacterial cultures; time for healing or encapsulation given; then, the balls being broken, liberation of their contents; still later injection of cocci into the injured tissue.

Subcutaneous injections of infected fluids.

Injections of cocci into old scars.

Encapsulation of shreds of wool which had been saturated with pyogenic cocci; these were tried in the joints, peritoneum, subcutaneous tissue, etc.

These last were undertaken especially with a view to determine whether mechanical injuries to tissues with exclusion of oxygen predispose to bacterial proliferation; and only in this last series was suppuration produced at all, and here only when the wool threads were infected. Even then the suppuration was not progressive in character and the cocci seemed to starve very quickly.

It appears then that mechanical lesions, *in loco*, do not predispose to bacterial, *i. e.*, pyogenic, activity, in other words to phlegmonous processes, *provided* that the locality is protected from access of air, that is of oxygen. In subcutaneous injuries absorption takes place too rapidly for the cocci to have time to form ptomaines, to disturb the tissues or to proliferate. Even in cicatricial tissue and in the neighborhood of scars, there is no *locus minoris resistentiæ;* resorption even here is scarcely hindered. The quicker the resorption the less noxious the bacteria. Rapid absorption and lively tissue-cell proliferation are really both protective in high degree; the "battle of the cells" being the defensive feature of the latter. Therefore lesions which cause an inflammatory reaction by no means predispose to metastatic suppuration.

Mechanical disturbance can also afford to cocci previously present in the tissues opportunity to set up a suppuration, by gaining access to some foreign body penetrating the tissues, and there producing ptomaines by whose help the process is established. That such a process is purely local is brought about by the factors just mentioned above.

In further elucidation of the precise part played by purely chemical agencies—by ptomaines like cadaverin, or by caustics like ammonia or croton oil—which without bacterial help can provoke a muco-fibrinous exudate, Rinne carried out yet another series of experiments intended to show whether there could take place an emigration of microbes from other parts of the body into an inflammatory focus caused by such chem-

icals.   After producing such foci in various animals (dogs and rabbits) pure cultures of pyogenic cocci were injected:

   a. Subcutaneously at distant points.

   b. In the abdomen.

   c. In the circulation.

In no instance could these cocci be recognized at the point in discussion; not even when extensive phlegmon was produced at the point of bacterial infection.

The order of the lesions was then reversed, without altering the result.

When an actual necrosis of tissue was produced then sometimes a penetration of ordinary bacteria from the air was observed, but nothing more.

Sometimes along with the croton oil, cadaverin, etc., the pyogenic cocci were injected at the same time, and then acute phlegmon was often produced, along with partial skin gangrene, and then the above cocci would be found along with other forms.   But more often the result was a severe caustic action with extended necrosis and then mummification.

From these it appears that such chemicals of themselves produce no spot of least resistance for pyogenic cocci; and further that ammonia or cadaverin, when sterilized, may

   1. In a certain concentration produce abscesses with sterile pus (puruloid).

   2. Or prepare the soil for bacteria which are injected with them.

   3. Or by destroying the overlying skin permit access of any of the organisms from the air; but that *they cannot* open the pathway for bacteria from the blood of the same individual; the explanation for which is probably to be found in a very lively cell proliferation.

Accordingly while it thus appears that chemically produced lesions do not predispose to bacterial activity, it further is seen that just as little also do the subcutaneous inflammations thus produced favor metastatic suppuration or become *loci minoris resistentiæ*.

Finally Rinne propounds this query: Wherein lies the key to the comprehension of those cases where abscess occurs

without our being able to recognize any disease or point of infection?

Everything points to the impossibility of a purely spontaneous suppuration, as well as to the complex character of various contributing factors. And first of all the histories elicited are seldom of value enough to shed real light, and examinations of patients are seldom scrutinizing enough.

Then it must be remembered that the lesion permitting entrance of bacteria may be healed before the abscess comes under observation; *e. g.*, pelvic abscesses or endocarditis puerperalis ulcerosa some time after puerperal fever, etc. Thus Grawitz reported to Rinne a case where a purulent basilar meningitis was traced along the second branch of the trifacial nerve, and found to have its origin in a furuncle just over the infra-orbital foramen, which had almost healed.

Moreover the primary lesion may present no clinical signs and so be passed unnoticed; *e. g.*, the abscesses or meningitis known to follow pneumonia. Probably so-called idiopathic peritonitis or pleuritis, like the so-called rheumatic, come under this category.

Acute infectious osteomyelitis was formerly regarded as a purely idiopathic disease; now we know that it is a staphylococcus infection, but sometimes find it difficult to trace the path of infection. It may follow typhus, scarlatina and diphtheria, or perityphlitic or pelvic abscesses, for instance, which may have been long past; or it may follow some external furuncle or phlegmon.

But it often happens that the septic or suppurative process has reached its height when the case first comes under accurate observation and that the lapse of time has obliterated in one way or another those evidences which might lead to a more speedy and accurate recognition of the prime causes for which we seek. Previous "feverish states" offer a much more plausible explanation for many cases of so-called spontaneous suppuration than do the majority of histories of injury.

REVIEWS OF BOOKS

A TREATISE ON MASSAGE, Theoretical and Practical; Its History, Mode of Application and Effects, Indications and Contra-Indications, with Results in over Fifteen Hundred Cases. DOUGLAS GRAHAM, M.D. Second Edition, Revised and Enlarged. New York: J. H. Vail & Co. St. Louis: J. H. Chambers & Co., 914 Locust Street.

This second edition has been enlarged to three hundred and thirty-five pages by two new chapters, one on Local Massage for Neurasthenia, the other on the Treatment of Scoliosis by Means of Massage; and by numerous minor additions, many of which are merely confirmatory of previous statements.

The work opens with two interesting chapters on the history of massage, replete with ancient lore. Following this are chapters on the mode of applying massage, and its physiological effects. Then come numerous chapters on the treatment of morbid conditions by means of massage. These are abundantly illustrated by clinical examples, for the author prefers to bring forth illustrative cases rather than the deductions from them alone. In fact the arguments in which he seems to delight for the support of his theories are of this undisputable character. He cites not only from his own experience, but gives case after case from the records of other observers.

As do most writers upon such special subjects, he falls into the error of giving the impression that the subject upon which he writes is the *res suprema*. It may be said, however, that no one shall read this work without sharing, in a degree, the enthusiasm of the author; for the clinical reports which he gives are such as appeal to every practitioner, and especially to those who have much to do with chronic diseases. Although we are told how, and when, and where to give mas-

sage, in the first of these is the stumbling block. Were the admin-
istration of massage as easy as that of pills and tinctures its use would
be more universal than any preparation in pharmacy. It requires toil.
When the professional mind is disabused of this idea, and when the
physician is as willing as the surgeon to give himself as a part of his
treatment, such works as Dr. Graham's shall find more eager readers.
The medical profession is urged to make massage more of a part of its
armamentarium, to elevate it from the hands of charlatans and the
uneducated, and give it the endorsement of science. "We ought not
to reject a useful means," said Nelaton, "because it has been used by
those unskilled in the medical art."

  Although in its essence this is strictly a scientific work, yet the style
is not that generally adopted by writers on scientific subjects. At
the head of each chapter are some lines of poetry or philosophic
quotation, such as the novelist is wont to use, bearing upon that chap-
ter. The text is interspersed with apt bits of humor and incidents,
which make the reading pleasing even aside from its intrinsic scientific
merit.

  The application of massage to surgery is fully set forth. A chapter
is devoted to the uterus and its appendages, with a report of two
hundred and thirty nine cases. Numerous cases of intestinal obstruc-
tion, especially those due to fecal impaction and intussusception, are
reported cured by massage. The author is surgeon enough to mention
the danger of such treatment in case of inflamed or otherwise weakened
gut. The most noteworthy chapters are those upon the treatment of
sprains and joint affections, for in these above all other lesions, mas-
sage has been nost succesfully employed. After reviewing these
statistics we may say with Malgaigne that, massage is "the soul of
orthopædic surgery." The use of heat, cold, rest, or pressure can
show no such results in sprains aud synovitis as does massage. Seven
hundred cases are reported, which show recovery in one third the usual
time under other methods of treatment. The interesting experiments
of von Mosengeil, upon the joints of animals, demonstrating the rapidi-
ty of absorbtion of fluids from joint cavities, are given to show how
this absorbtion is accelerated and how quickly a joint may be emptied

of fluid by means of massage. This evidence the author believes to be highly confirmatory that the synovial membrane, in its structure and functions, resembles the pleura and peritoneum, in which the respiratory movements, by their pump-like action, cause exuded fluids to be taken up and propelled onward in the lymphatic channels. So with the sheaths of tendons and joint membranes, by massage the lymphatic currents are excited to greater activity.

Some attention is given to the treatment of recent fractures of the patella by means of passive motion and massage. Such proceeding is not in harmony with modern surgical tendencies.

No physician will read this work without feeling an impulse to try his hand at massage. He will find that some tedious case in his practice is just the one for such treatment; a treatment that is destined to occupy a more prominent place in the curative art, and which is to be elevated to that position by such works as has just been our pleasure to review.   JAMES P. WARBASSE.

LEHRBUCH DER SPECIELLEN CHIRURGIE. VON PROF. DR. HERMANN TILLMANNS. Leipzig, Veit & Co., 1891; New York, G. E. Stechert; St. Louis, J. H. Chambers & Co.

TEXT-BOOK ON REGIONAL SURGERY.

This large volume of 1300 pages is the second part of the author's text book on general and regional surgery, the first part of which was noticed in this journal some time ago. The injuries and diseases of every anatomical region, of the various organs, and those of the extremities are here separately considered; and a complete operative manual as well as anatomical and pathological introductory remarks to each subject are included in the programme.

The book is very complete considering the fact that the whole of so-called special surgery has been treated in one volume. The methods given are generally the ones most accepted in Germany, but occasionally the author's individuality asserts itself more strongly, as is apt to be the case in a work of this character. As instances we may

mention that in the treatment of aneurism of the thoracic aorta the author favors electro-puncture; and in the treatment of fractures of the carpal epiphysis of the radius he advises the use of the curved volar splint, and Carr's splint. To most cases, where the author first gives his own method of treatment, other methods are briefly mentioned.

Altogether this volume impresses the reader much more favorably than the first one, although both bear evidence of being compiled with the same diligence. W. W. VAN ARSDALE

LEITFADEN DER BEHANDLUNG VON FRACTUREN UND LUXATIONEN DER EXTREMITAETEN MITTELST FEDER-RESP. GEWICHTS EXTENSIONEN. VON PROF. DR. BARDENHEUER. Stuttgart, F. Enke, 1890; New York, G. E. Stechert; St. Louis, J. H. Chambers & Co.

GUIDE TO THE TREATMENT OF FRACTURES AND DISLOCATIONS OF THE EXTREMITIES BY MEANS OF EXTENSION WITH THE HELP OF SPRINGS AND WEIGHTS.

But a short time ago we had occasion to review the large work by the same author on a similar subject; the treatment of fractures of every description by extension with weights, being one of the volumes of the "Deutsche Chirurgie." The volume now before us is in great measure condensed from the larger work, and is intended to be a more convenient hand-book for the practitioner. It contains over 200 pages large octavo, and is profusely illustrated. Each fracture and dislocation is separately discussed, as concisely as possible, and the most necessary information is given in regard to it. In the treatment, however, the special feature of the book is boldly brought forward, consisting in the author's method of treating every case of fracture by extension. As in the larger work all simple injuries to the lower extremities are treated by extension, the patient being placed in bed and traction made by pulleys and weights, (in as many as six different directions at one time in some cases,) in order to meet the various tendencies to displacement of the fragments.

In the upper extremity, however, the weights have been largely replaced by spiral springs, which may be compressed by means of a crank and toothed rod and which, being released, act in extending the two portions of the splint, previously made fast to the portions of the extremity corresponding to the fragments. The substitution of spiral springs for weights has the object of permitting the patients to go about, and receive treatment as out-patients.

The objections to the methods given, viz : the complicated arrangement and the expense of the cumbersome apparatus, is overbalanced, in the opinion of the author, by the more satisfactory results obtained. The time of treatment is also shortened.

In 3,300 cases of fracture treated after his method the author did not abserve any deformity, shortening, angular misplacement, inflammatory œdema. painful or excessive callus, pressure-paralysis, phlegmons, gangrene, nervous or vascular disorders. Nor were any cases of anchylosis observed excepting at the hip-joint.

As points of practical interest we may add, that the apparatus for fracture of the humerus (for example) weighs about two pounds and a half including the amount of adhesive plaster necessary to retain and affix it; its cost is about twenty-five dollars without duty; and may be procured from Hunzinger, Hockstrasse or from Klaes, Hosengasse, Cologne, Germany.   W. W. VAN ARSDALE.

ANNALS

OF

SURGERY

A MONTHLY REVIEW OF SURGICAL SCIENCE AND PRACTICE

EDITED BY

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Medical Letters may be addressed to:
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